MODELLING SOCIO-ECONOMIC EFFECTS OF IMPLEMENTING REDUCED-IMPACT LOGGING: A CASE STUDY OF BERAU DISTRICT EAST KALIMANTAN PROVINCE INDONESIA

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ABSTRACT

Reduced-impact logging (RIL) was identified as a measure, complementary to other identified measures, which can contribute to Indonesia reducing emissions from forestry and forest degradation (REDD+). In this light, the research was aimed to investigate the economy-wide impact of implementing RIL on the economy, which was studied at the district level. For this purpose, an expert opinion survey method was integrated with Berau computable general equilibrium (CGE) model. The expert opinion survey was utilised to: (i) generate information and confirm the impact of implementing RIL on logging costs, and (ii) obtain an estimate of the incentive required by logging companies to maintain the practice of RIL. Results of this approach provided input to the Berau CGE model. In addition, multiple ways of data gathering were employed to develop the dataset required for the general equilibrium analysis.

Simulation results suggest that the economic impact of implementing RIL policy is negative but small on the Berau economy compared to a situation where the RIL is not implemented. Worker households (particularly agricultural worker households) are worse off and non-agricultural households are better off. Furthermore, providing compensation, which was simulated as a logging output-based subsidy, can improve the Berau economy, although to only a lesser degree.

The RIL policy causes a significant negative impact on logging output which further leads to output reduction in forest-based and pulp & paper industries. The policy implementation, however, simulates production increase in other agricultural activities, notably in oil palm plantation. Furthermore, results simulations with the logging output-based subsidy suggest the magnitude of economic impacts is reduced from what would otherwise occur in the scenario of implementing RIL only (no subsidy is provided).

The RIL policy also seems to result in ‘unexpected’ emissions leakage indicated by increases in output of some agricultural-based activities such as oil palm plantation, other estate crops, and food crops. Increase in emissions is also expected to occur outside the Berau District stimulated by the increase in the District’s import of timber.

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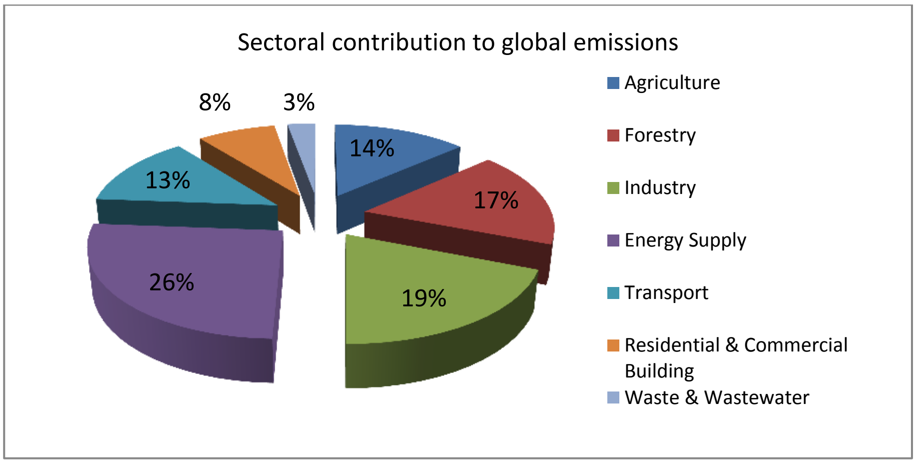
Chapter 1 Introduction

This chapter introduces the overall reason for undertaking the study, including the problem statement, research questions and the organisation of the study. It provides general information on the reducing emissions from deforestation and forest degradation in developing countries (REDD) framework. The background is extended in Chapter 2 along with the tools to be utilised to achieve the proposed aim of the study.

1.1 Background

Global annual emissions of anthropogenic GHGs[1] in 1970, 1980, 1990, 2000 and 2004 were recorded at 28.7, 35.6, 39.4, 44.7, and 49.0 Giga tonnes CO2 equivalents / year respectively. In 2004, the forestry sector was estimated to contribute 17.4 % of the world's total emissions and agriculture, industry, energy supply and others contributed the rest, as seen in Figure 1.1 (Intergovernmental Panel on Climate Change, 2007).

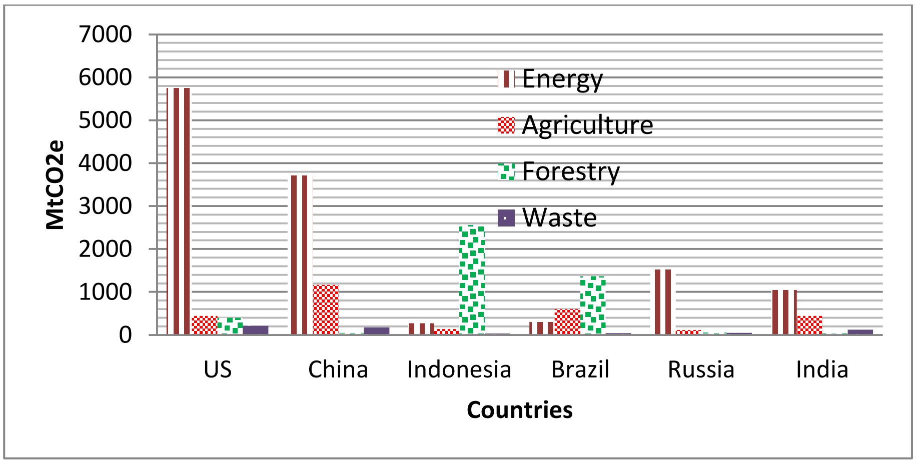


Source: IPCC, 2007

[1] Emissions covered by the United Nations Framework Convention on Climate Change (UNFCCC) include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and F-gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphurhexafluoride (SF6)

Figure 1.1 Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO2-eq. (forestry includes deforestation)

Indonesia is the third largest annual emitter in the world with total emissions of 3014 MtCO2e, following the US and China with 6005 MtCO2e and 5017 MtCO2e respectively. With the European Union block included, Indonesia comes in at 4th (The World Bank, DFID, & PEACE, 2007)[2]. A large part of the Indonesian emissions comes from land use change and forestry, Figure 1.2. Together with Brazil, Costa Rica, Congo, and the Democratic Republic of Congo, these countries' emissions' figures reach nearly 75 % of the world's forestry sector emissions of 1.65 Gigatonnes Carbon per year (Ministry of Forestry, 2008).



Source: The World Bank, 2007

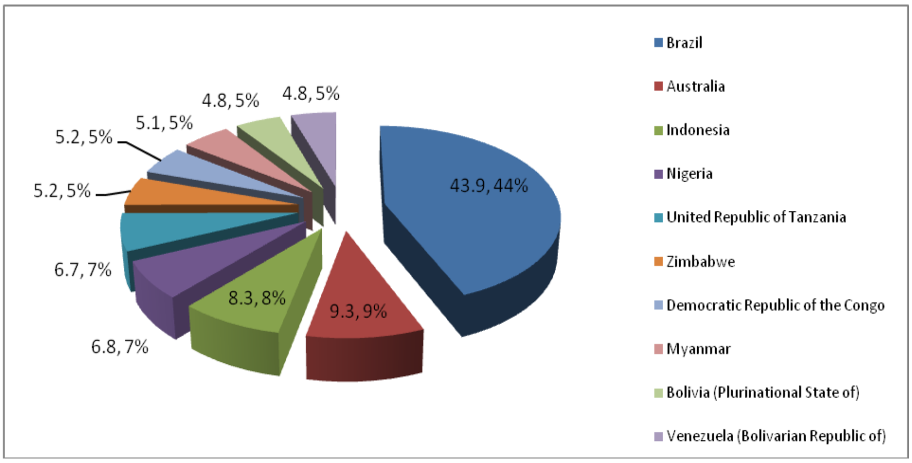
Figure 1.2 Greenhouse Gas Emissions Summary (in $MtCO_2e$)

FAO (2010) also reported ten countries with large annual deforestation in the period of 2000 – 2010, as presented in Figure 1.3. Deforestation and forest degradation are mainly driven by anthropogenic activities and occur mainly for economic reasons (Intergovernmental Panel on Climate Change, 2007)[3]. Globally the three main drivers of deforestation are agricultural expansion, infrastructure

[2] In 2005, excluding emissions from forestry and land use change; Indonesia ranked 12th in the world emissions (World Resource Institute).

[3] Although FAO differentiates between deforestation and forest degradation definition, some literatures intertwine them. Unlike the UNFCCC term, FAO includes deforestation from all causes.

development and wood extraction (ECORYS Research and Consulting & IIASA, 2010). Drivers of deforestation may vary from region to region, for example, the primary driver in Australia is severe drought and forest fires.



Source: FAO (2010 p.21)

Figure 1.3 Share of annual deforestation from 1990 to 2000

Macroeconomic policies, economic crises, infrastructure development, local politics and local culture jointly determine the deforestation rate of a nation. In Latin America, most cleared forest has been converted to pastureland to meet an increasing demand for meat and dairy products. Ranching and soybean production are major drivers of deforestation in Brazil. Brazil faces further potential forest degradation owing to the establishment of more than 10 million hectares of forest concession on public lands (Banerjee & Alavalapati, 2009a) if those are not managed properly. Meanwhile, in South Asia and Central Africa, most forest is cleared for the cultivation of food crops and timber production from this conversion. Additionally, forest degradation also occurs because of unsustainable extraction of wood and non-wood forest products and grazing in the more heavily populated countries, especially those in South Asia (CIFOR, 2009; ECORYS Research and Consulting & IIASA, 2010; Food and Agricultural Organization, 2009). Legal and illegal logging and expansion of large-scale commercial plantations such as for oil palm plantation, cause most deforestation in Indonesia.

In Indonesia, the forestry sector played a significant role in the national and sub national economy. More than half of the country's forests are natural production forests (approximately 54 million hectares) and have provided tropical hardwood logs and sawnwood, plywood and other wood-based panels, and pulp for papermaking. In addition Indonesia has non-actively logged natural forests and two million ha of timber plantation forests (Forest Watch Indonesia, Global Forest Watch, & World Resources Institute, 2002).

The forestry sector's rapid expansion in production and exports in the 1980s and 1990s has been achieved through unsustainable logging practices. Indonesian wood processing industries are estimated to consume about 80 million m3 of roundwood annually -- far more than can be produced legally from the country's forests and timber plantations -- more than half the country's total wood supply is estimated to be derived from illegal logging (Forest Watch Indonesia et al., 2002). The consequences of the expansion of logging are rapid deforestation and forest degradation.

Indonesia's ambition to be a world leading producer of crude palm oil has increased deforestation and conversion of natural forest to oil palm plantations. Hannibal (1950) as cited by Harris (2008) states that 84% of Indonesia's total land area of about 193 million ha was forested in the 1950s. The percentage of forested area had decreased to only 69% of the total area in the 1990s. The Indonesian Ministry of Forestry's official estimate of deforestation is 1.08 million ha per year (Kementerian Kehutanan, 2008); a half of Global Forest Watch and WWF's estimate of 2 million hectares per year (Harris et al., 2008).

The fact that forests have been widely recognised for their important role in offsetting carbon from the atmosphere leads to the international community's increasing concern over current levels of emissions due to deforestation and forest degradation in developing countries. International negotiations under the Climate Change framework agreed on establishing a mechanism to avoid deforestation, or to reduce deforestation from deforestation and forest degradation (REDD) in developing countries, which was adopted as part of GHG mitigation strategies at COP 13 UNFCCC, December 2007. The REDD concept enables developing countries to engage in reducing emissions through avoiding deforestation and forest degradation while maintaining their economic development through the provision of positive incentives (United Nation Framework on Climate Change, 2005). The REDD framework has recently evolved into REDD Plus or REDD+ mechanism owing to the inclusion of other activities such as forest conservation, sustainable forest management and carbon stock enhancement (ECORYS Research and Consulting & IIASA, 2010; The Nature Conservancy, 2010).

A voluntary mechanism for reduction of emissions from deforestation and forest degradation in developing countries has been agreed under the UNFCCC decision No. 13/2007 (United Nation Framework on Climate Change, 2008). A series of demonstration activities were planned in 2007 at both sub-national and project level within the developing countries across Africa, Latin America and Asia (see www.UN-REDD.org), using financial assistance of partner countries or institutions.

There are various mechanisms in which the REDD++ could be implemented. One way to create incentives for conserving forests and distributing REDD payments to those contribute to conservation is through a payment for environmental services (PES) mechanism. However, compared to existing PES Schemes which attempt to compensate or provide incentive for service providers ‘to undertake’ particular activities, the REDD+ PES encourages the service providers to avoid activities that produce emissions (Martin, 2010). He further states that direct payment to individual or community level is possible. There are some previous experiences of carrying out direct transfers into communities for compensating ecosystem services that they provide. Most researches on PES scheme emphasise on analysing ways and (direct) effects of distributing the payments (Couto Pereira, 2010; Engel, Pagiola, & Wunder, 2008; Kosoy, Corbera, & Brown, 2008; Milne & Niesten, 2009). Most studies of PES schemes focus on a cost-benefit analysis of the studied project/activities rather than assessment of potential impacts of the activities within the whole economy. Hence, a model that is able to capture the overall economic impacts is required.

1.2 Problem Statement

Indonesia has experienced a significant problem with emissions from deforestation and forest degradation especially since the 2000s. Forests are threatened by the expansion of oil palm plantations, forest fires, illegal logging and coal mining. Increasing concern by international communities has been translated into a global mechanism to reduce emissions from the deforestation and forest degradation in developing countries, including sustainable forest management, increasing carbon stock and conservation (REDD+). Indonesia is actively involved in this initiative and has been formulating its national strategy to cut its national emissions. At the operational level, several demonstration activities to reduce emissions from deforestation and forest degradation have been proposed by the government with the cooperation of external institutions in some parts of Indonesia. A model that can quantify the economic impacts of various proposed projects will assist in evaluating and selecting among candidate projects, and quantifying the impacts of these schemes on the wider economy

1.3 Main objective

This study aims to investigate the potential socio-economic impacts of adopting strategies to reduce emissions from deforestation and degradation (REDD+) in Berau District. This will be studied at the district level.

1.4 Research questions

The main objective will be achieved through answering the following research questions:

- How can the consequence of a selected a measure to reduce emissions i.e. reduced-impact logging technique to the logging cost be assessed?

- How can an incentive level required in order the logging company to comply with the above measure be estimated?
- Given the answers, what are the economic impacts of the REDD+ -based policy on Berau District?

1.5 Contribution

The proposed research will provide:

- A demonstration of the construction and utilisation of a district level general equilibrium model to understand forestry's contribution to regional development.
- Information and analysis of the potential socio-economic impacts of applying reduced-impact logging.(as a REDD+ measure) at the district level in Indonesia i.e.
- Inputs for better decision making with regard to the implementation of the reduction of emissions from deforestation and forest degradation in Indonesia.
- Insights into existing and 'traditional' impact evaluation analysis relevant to REDD+ demonstration activities.

1.6 Organisation of the thesis

The thesis is organised as follows. Chapter 1 provides a general introduction to the rationale for this study, while a focus of Berau District East Kalimantan Province Indonesia as a case is presented in Chapter 2. Chapter 3 presents a literature review on CGE analysis as the main research tool used in the study. Chapter 4 and Chapter 5 provide a CGE methodology and methodology to construct CGE dataset for the modeling, respectively. Chapter 6 depicts the process of construction the dataset for the modeling i.e. a social accounting matrix (SAM) for the Berau District. Subsequently, a Berau economy is briefly described based on the analysis of the constructed SAM, as in is briefly analysed and presented as Chapter 7 presents a brief analysis of the Berau District Economy from the constructed Berau SAM.

Chapter 8 review experts' opinions technique and utilises the methods to estimate selected forests stakeholders' compensation level to engage in particular approaches to REDD+ program in the Berau District. A policy scenario is also developed in this Chapter which will subsequently be used for a CGE simulation in Chapter 9.

The Chapter 9 presents results and discussion of baseline and applying reduced-impact logging simulations. Next, Chapter 10 provides results of a sensitivity analysis of CGE with regard to a selected parameter and varying the RIL policy. Finally, Chapter 11 gives conclusions and recommendation from the overall studies.

Chapter 2 Indonesian Forestry and Reducing Emissions from Deforestation and Forest Degradation (REDD+)

This chapter describes the implementation of the REDD+ policy in Indonesia. The current forestry situation in Indonesia is described, followed by a review of the problem of deforestation and forest degradation. The Indonesian national plan to implement the REDD+ policy is presented, and the selected study location for the demonstration activity to reduce emissions from deforestation and forest degradation is described.

2.1 Indonesian Forestry in Brief

With 17,508 islands, Indonesian land is recorded to be 187.8 million hectares, and 71% of the land is forest area[4] (Kementerian Kehutanan, Kementerian Pertanian, & UNREDD, 2010, p. 10). The Indonesia forest area is recorded at 133,841,805.91 ha and is the world's third largest area of tropical forest after Brazil and Congo. This excludes forest area that has been assigned for other purposes or the APL (*Area Peruntukan Lain*) category of 55,386.9 million hectares (Departemen Kehutanan, 2009).

Indonesian forests are mainly grouped into the forest area (133.6 million ha or 71%) and the APL areas or forests that have been allocated for other uses (55.4 million ha or 29%). Papua Island has the largest forest area of 40.6 million ha, followed by Kalimantan, Sumatera and Sulawesi with 40.9 million ha, 27.9 million ha, and 12.5 million ha respectively. The rest is distributed among other islands such as Java, Bali and Nusa Tenggara. The Indonesian forests are classified according to functions including as production forest (81.9 million ha), protected forest (31.6 million ha) and conservation forest (19.9 million ha). In addition, there are 55.4 million ha of land under the APL (*Area Peruntukan*

[4] In Indonesia, the term 'forest area' refers to areas that fall under 'forestry utilisation' and it does not necessarily need to be forested.

Lain/allocated for other use) category and 8.4 million ha of this APL are still well forested.

In Indonesia, as in other parts of the world, forests are important from the social, economic and environmental points of view. All areas of society have an interest in forests: civil society (including communities, *adat* (customary) groups, women, religious groups, NGOs and watchdog groups), large and small business, unions, educational institutions, the media, local governments and politicians, law enforcement agencies and the central government (The World Bank, 2006).

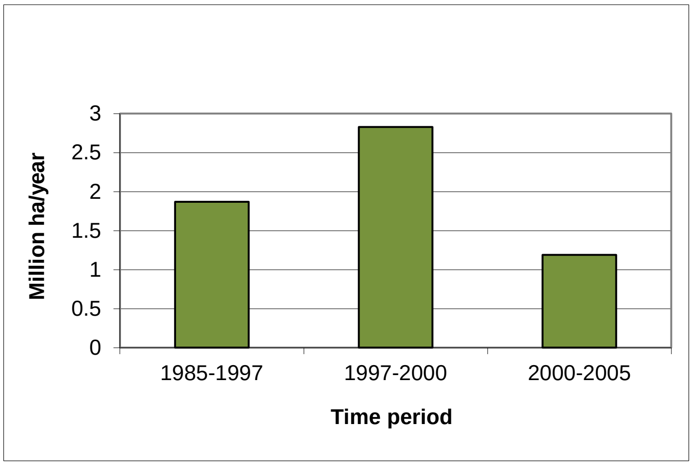
The Indonesian forestry sector has played a significant role in national development over the last 30 years through provision of government revenue, job opportunities, rural development and economic development (Ulya & Yunardy, 2006). Within the period 1993 to 2004, the forestry sectors contributed national earnings from IDR 1.16 trillion to IDR 3.37 trillion, through government collection of forest concession licence fees, the reforestation fund, the reforestation guarantee fund, forest product royalties and the performance bond. The employment level in the forestry industry is recorded to be between 500 and 600 thousand, excluding workers in smaller forestry-based industries. (Simangunsong, Manurung, & Sukadri, 2007).

The contribution of forestry to the national economy from 2004-2009 has been nearly 1% of the national gross domestic product which is half of the 2003 figure (The World Bank, 2006). Combining the forestry sector and the wood industry sector, their contribution are between 2% to 2.3 % of the total national gross domestic products in the period of 2004-2009 (Badan Pusat Statistik, 2010). Reasons of the declining of the forestry sector are decrease in log supply from natural forest, less successful in timber plantation, inefficiency and high economy in timber production, the global crisis, trade barriers and environmental issues (Ramitha, 2010).

2.2 Reducing Emissions from Deforestation and Forest Degradation (REDD)+ in Indonesia

Deforestation in Indonesia

Indonesian forestry sector's rapid economic expansion in production and exports in the 1980s and 1990s has been achieved at the cost of unsustainable logging practices (Forest Watch Indonesia et al., 2002) and lead to rapid deforestation. Indonesia's ambition to be the world's largest palm oil producer is also cited as a cause of accelerated deforestation as more forests are converted into oil palm plantation. Harris (2008) stated that in the 1990s, 69% of Indonesia's land area was forested, a significant decline from 84% of the land area in the 1950s. Global Forest Watch and WWF estimate that the rate of Indonesia's deforestation rate at 2 million hectares per year, a higher figure that the figure released by the Indonesian Ministry of Forestry of 1.08 million hectares per year (Kementerian Kehutanan, 2008).



Source: Ministry of Forestry (2008)

Figure 2.1 Deforestation Rate in Indonesia for the period 1985 to 2005

Figure 2.1 shows the deforestation rate in Indonesia in three periods between 1985 to 2005. From 1985 to 1997, the rate of deforestation was recorded at 1.8 million ha per year. In this period, there has been extensive logging and expansion of the oil palm establishment. After a monetary crisis in Indonesia in 1997, followed by the fall of Suharto's regime, Indonesia experienced a new era of democracy marked by decentralisation to local governments. This decentralisation of decision-making was accompanied by an increase in deforestation, to the highest rate of 2.8 million ha per year for the period 1997-2000. Subsequently, for the period 2000 - 2005, the government of Indonesia has exerted more control over the forestry sector to reduce the deforestation rate, though is still more than 1 million ha per year.

FAO notes that Indonesia reported a very significant drop in its rate of net loss in the 2000–2005 period compared with the 1990s and, although the rate increased again in the last five years, it is still less than half that seen during and shortly after the peak of the large-scale transmigration programme in the 1980s and early 1990s. This drop is consistent with other recent findings based on the use of remote sensing as reported by Hansen et al. (2009).

Sources of deforestation and forest degradation

The Indonesian Ministry of Forestry (2008) identifies both planned and unplanned deforestation. Two major drivers of planned deforestation are the expansion of forest plantations and oil palm plantations. For forest plantation development, the government has set aside over 10 million hectares for industrial plantation concessions. Another 5.4 million hectares has also established for community timber plantations up to 2016. Most of the timber plantation establishment is intended to satisfy the pulp and paper industry's resource demand. Forest lands allocated for the timber plantation fall under the forest production class and they vary from vegetated to heavily degraded forest lands (Ministry of Forestry, 2008).

The oil palm plantations are estimated to reach 10.8 million ha in 2013 (Foreign Agricultural Service USDA, 2013). The oil palm sector has become a valuable source of foreign exchange, national income and employment. A study by IFCA reports that a hectare of oil palm in Indonesia over 25 years generates an NPV of US$ $2,650 to $3,388 depending on location. The expansion of oil palm takes place at the expense of natural forest and continues to become a source of wildfire and peat degradation (Ministry of Forestry, 2008). The government recently agreed to establish 1 million hectares of paddy field in outer Java islands such as in Kalimantan and Papua[5].

Illegal logging and forest-land occupation (for food crops and estate plantation) are important and widespread causes of unplanned deforestation. These deforestation drivers are usually associated with lack of enforcement, lack of incentives to manage protected areas, and low capacity within institutions to manage the forest area. Unplanned deforestation resulting from illegal logging and encroachment occurs on both protected and natural production forests (Ministry of Forestry, 2008; Palmer, 2001).

Action plans towards REDD+ in Indonesia: in Brief

The government of Indonesia has formulated its national strategy on GHG emissions reductions within 'the National Action Plan of GHG Emissions Reduction' or *Rencana Aksi Nasional Pengurangan Emisi Gas Rumah Kaca* (RAN-GRK). The REDD+ National Strategy Plan is formulated as part of the RAN-GRK. The President of the Republic of Indonesia, Mr. Susilo Bambang Yudhoyono has declared the voluntary cutting of Indonesia's carbon emissions by 26 percent by 2020 through the national budget and up to 41% using additional international funds. The forestry and land-use based sectors are expected to contribute 14 to 26 percent[6] of the total reduction (Kementerian Kehutanan et al., 2010).

The REDD+ National Strategy Plan (Kementerian Kehutanan et al., 2010) frames strategies to reduce emissions from deforestation and degradation through:

- Improving space planning and utilisation in the framework of emission reduction while sustaining national economic growth,

[5] http://http: //www.detikfinance.com/read/ 2011/01/07/ 203507/1542084/ 4/pemerintah- janji-tambah- 1-juta-hektar- lahan-padi? f9911023

[6] *Government in the dark on how to cut emission*. The Jakarta Post , Jakarta | Wed, 11/25/2009. Cited 25 November 2009.

- Increasing control and monitoring of the progress of emission reduction,
- Increasing effective management of forest and peat-land,
- Increasing stakeholders' involvement including local communities (*adat*) surrounding the forests,
- Strengthening law enforcement systems.

In accordance with the aforementioned national strategy, the Ministry of Forestry declared Forestry Decree No. 70/2009 (Kementerian Kehutanan, 2009a) concerning the ministry's eight priorities programmes, as the following:

- Re-establishing forest areas,
- Rehabilitating the forest and improving watershed areas' carrying capacity,
- Forest guarding and forest fire control,
- Conserving biodiversity,
- Revitalising forest utilisation and forest industry,
- Empowering forest communities,
- Mitigating and adapting to climate change in the forestry sector, and
- Strengthening forestry institutions.

Indonesia and partners are setting up demonstration activities to reduce emissions from deforestation and forest degradation in accordance with the COP 13th UNFCCC's decision No. CP.13/2007 (concerning Reducing Emissions from Deforestation in Developing Countries: Approaches to Stimulate Action (United Nation Framework on Climate Change, 2008), The purpose of the REDD demonstration activities are twofold, i.e. to reduce emissions from deforestation and forest degradation and to provide shared information to international communities about REDD. Implementation of sub-national REDD activities is critical before a country establishes its reference scenario that allows the national accounting for GHG emissions from REDD. Sub-national activities that account for local emission reductions could generate REDD credits in advance of national schemes that could be sold on international carbon markets (Streck, 2010).

The Indonesian Minister of Forestry established a minister decree No. P.68/2008 concerning the implementation of REDD demonstration activities (Kehutanan, 2008). The decree states that the demonstration activities are directed towards testing and developing methods, technology and institutions that sustainably manage forest through controlling deforestation and forest degradation as well as implementing forest management activities relevant to reducing emissions from deforestation and forest degradation (Kehutanan, 2008).

Criteria and indicators for selecting locations suitable for REDD demonstration activities at the sub-national level are regulated by Attachment 1 of the Minister of Forestry's decree No.P.30/2009 concerning procedures to reduce emissions from deforestation and forest degradation (Kementerian Kehutanan, 2009b). These are: (1) governance (synergy between local economic development programmes and REDD), (2) biophysical conditions, e.g. area of forest and peat land, threat of deforestation and forest degradation from illegal logging and forest fire, (3) socio-economic aspects (forest value, forest dependent community), and data availability and capability related to REDD (Kementerian Kehutanan et al., 2010). In addition to providing guideline on criteria and indicator for selecting appropriate REDD demonstration activities, the regulation of P.30/2009 also provides a general guideline on distributing incentive payments received from the REDD activities.

Several REDD demonstration activities of Indonesia have been planned with the cooperation of the governments of Australia and Germany, the International Tropical Timber Organization (ITTO) and The Nature Conservancy (TNC). Locations of the proposed pilot activities are in the provinces of Jambi, West Kalimantan, Central Kalimantan, and East Kalimantan. ITTO has also established a REDD-related pilot project in Meru National Park in East Java Betiri; TNC is conducting a REDD pilot activity in Berau, East Kalimantan through the Berau Forest Carbon Programme (BFCP)[7].

Potential REDD+ Impact to Indonesia Economic Growth

It is argued that the implementation of REDD+ has the potential to accelerate growth and prosperity in Indonesia (Wardojo & Fishbein, 2011). The same authors point out that REDD+ can be considered: (i) as a smart strategy to

[7] See www.worldagroforestrycentre.org

growing the economy with less likely impact to forests e.g. through reduce impact logging and improved forest management, (ii) that it enhances country's competitiveness and access to global markets e.g. through provision of legally supplied and sustainable products of forest product, palm oil, and other commodities, and (iii) that it improves the natural resources for long term national prosperity.

However, a recent report of the World Growth Organisation (2011) on Indonesia suggests the opposite. Adoption of the REDD+ will likely have impact on both economic and environmental impacts due to several reasons (World Growth, 2011):

- The World Growth Organisation (2011) stated that economic models, which are based on the US economy, developed by McKinsey and Company to suit developing countries of Guyana, PNG, and Indonesia suffer from serious flaws Those models have never been assessed independently model;
- The typical economic growth generators, in Indonesia, are forestry, mining and palm oil sectors, sectors that require (forests) lands. The REDD+ attempts to address this by establishing moratorium of granting new licenses for these sectors which is most likely to slow economic development,
- Study on establishing more protected forest suggests that benefits from the protected forests accrue at national and international levels while costs is borne by local communities. The costs include physical displacement, land tenure changes and restriction to resources. Further study shows that establishment of protection areas does not necessarily improve biodiversity.
- It is reported that protected areas could not obviously contributes to the economic as much as the contribution by timber extraction and related wood-processing industry.

In conclusion, The World Growth (2011, p.3) states:

> "The programs [of REDD+] will have little impact on greenhouse gas emissions, but are guaranteed to reduce economic growth in the developing countries to which they are targeted."

2.3 Berau District and Berau Forest Carbon Programme (BFCP)

2.3.1 The Berau District

Berau District is one of 10 districts in the East Kalimantan Province and located at the eastern part of the Province. Having an area of 34,127 km2, the District lies between 116º to 119º E longitude and between 1º to 2º 33’ N latitude. The District shares its border with Bulungan District to the north, Malinau District, West Kutai District and Kartanegara District to the west, East Kutai District in the south and Sulawesi sea in the east (see Figure 2.2).

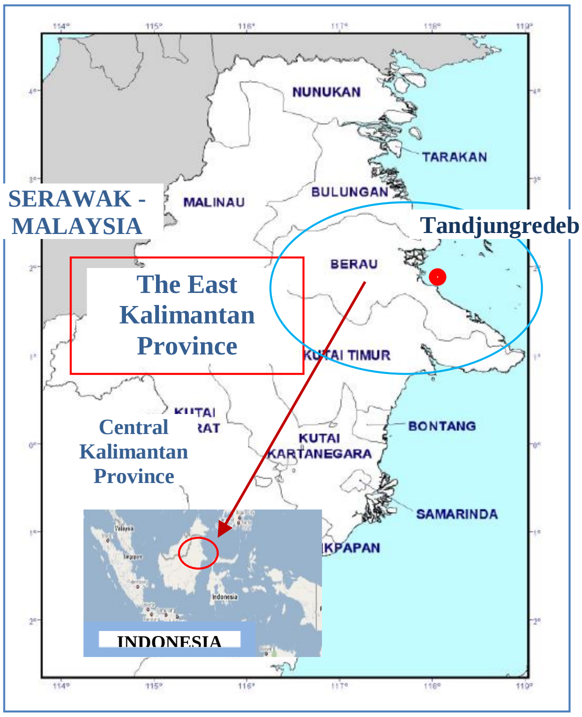


Figure 2.2 Map of Berau District, the East Kalimantan Indonesia

The capital city of Berau District is Tanjung Redeb. The Berau District consists of 13 sub districts, 97 rural villages (*Desa*) and 10 urban villages (*Kelurahan*). The district’s population is 165,501 (2007) people or 6 % of total population of the East Kalimantan (2.8 million, at 2005). Hence, the population density of the district is 4.8 people per km2. The population’s growth in 2007 and 2006 were 2.56% and 1.87% respectively. The Berau District has a varied topography, with slope ranging from flat to steep, with 0-2,450 m above sea level. The District is blessed with a complete range of forest types such as mangrove forests, swamp forests, and peat swamp forests at the coastal area, through *Dipterocarpus* forests and low mountain forests. It has tropical humid weather with rainfall ranges from 105.9-493.1 mm per month, being the lowest at September and the highest at February (Badan Pusat Statistik Kabupaten Berau, 2008).

Table 2.1 Forest area by category by administration levels, 2007

	Administrative Level (in ha)		
Category	**National**	**East Kalimantan Province**	**Berau District**
	(1)	**(2)**	**(3)**
Protection Forest	31,604,032.02	2,966,740.26	353,775.00
Conservation forest	19,908,234.57	2,081,832.10	
Permanent Production Forest	36,649,918.43	4,542,364.29	758,049.00
Limited Production Forest	22,502,724.26	5,245,776.43	786,975.00
Conversion Forest	22,795,961.00	5,528,174.48 ***)**	328,950.00
Others	233,814.90	781,762.00	
Total	**133,694,685.18**	**21,146,649.56**	**2,227,749.00**
		or 15.618,475.08 without ***)**	

Sources:

Columns 1 and 2: Ministry of Forestry Republic of Indonesia, 2008 (Kementerian Kehutanan, 2008)

Column 3 : Berau District Statistic Office

*) in the 2007 MOF statistic, this area has been excluded from forestry sector.

Table 2.1 indicates that the forests of East Kalimantan Province represent 16% of all forests in Indonesia. The total forests area of the East Kalimantan Province ranks third after Papua Province (including West Papua Province) and Central Kalimantan Province, whose areas comprise 40.54 million hectares and 15.3 million hectares, respectively. Using the current data (of 1.6 million hectares of forests), Berau forest area represents 7.5% of the East Kalimantan Province's forests.

According to Indonesian Ministry of Forestry statistics, total roundwood production of the East Kalimantan Province was 2.6 million m3 in 2007 or about 7 % of the national production. The East Kalimantan province's total production was in the fourth rank following Riau, Jambi, and South Sumatra which were 21 million m3, 3.7 million m3, and 2.7 million m3 respectively. The East Kalimantan Province, however, has been the largest natural roundwood producer in Indonesia, since the other four provinces' timber has been dominated by roundwood from plantations. East Kalimantan produces 24% of Indonesia's roundwood from selective logging production. Meanwhile, an official BPS record suggests that Berau District produced more than 500,000 m3 in 2001 (Obidzinski & Andrianto, 2005). The following Table 2.2 supports this view.

Table 2.2. Roundwood production by sources at national, selected provinces, & Berau District, 2007

Administration level	Source			Total Roundwood Volume (m^3)
	Selective Logging of Natural Forests (m^3)	Plantation Forests (m^3)	Others, mainly from land clearing (m^3)	
	(2)	(3)	(4)	(1)
National	6,437,684.54	20,614,208.77	9,335,342.01	36,387,235.32
Riau	652,967.94	17,771,434.25	3,911,763.25	21,030,229.56
East Kalimantan Province	1,554,612.03	418,056.79	634,801.05	2,607,469.87
- Berau District				521,965.00
North Sumatera	1,194,149.60	4,267.74	155,378.83	1,353,796.17
Jambi 2)	104,243.30	21,694.60	3,617,168.93	3,743,106.83

Source: Kementerian Kehutanan (2008); Obidzinski & Andrianto (2008)

Note: [2]) For Jambi Province, out of total roundwood produced, 2,977,626.25 m^3 was from land clearing for industrial plantation forest.

Economy and trade

Berau has a relatively high economic growth rate compared to East Kalimantan Province, and has about the same rate as Indonesia (see Figure 2.3). Berau was also affected by an economic transition occurred in the Province in the 2000s[8]. For example, there has been a boom in coal mining in the Province and District. In 2007, coal mining has been major contributor accounting for 37.72% to the District's gross domestic product; taking over timber sector which is only 9.57%

[8] Mr. Budy Resosudarmo, personal communication

(Badan Pusat Statistik Kabupaten Berau, 2008). Oil palm is also a growing activity which has been starting in 2007. It is reported that almost 200,000 ha of forestlands has been allocated to 33 companies for oil palm establishment (SEKALA, no year). Further information on the Berau economy is presented in Chapter 7.

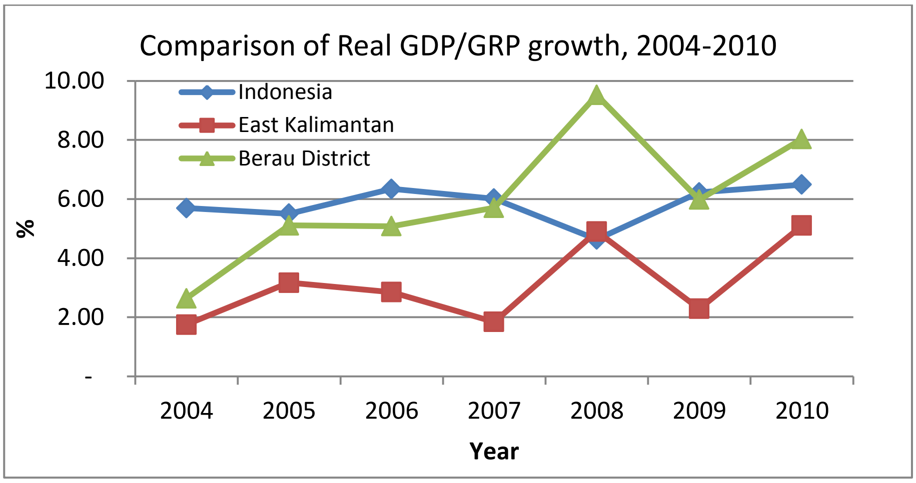


Figure 2.3 Comparison of real GDP/GRP Growth of Indonesia, Berau District, and East Kalimantan Province, 2004 – 2010

The Berau District also trades commodities and services to rest of Indonesia and with other countries. In 2007, total values of exports and imports[9] are recorded to be IDR 3,027.03 billion and IDR 808.89 billion, respectively. The respective values of exports and imports went up to IDR 3,239.46 billion and IDR 1,842.28 billion in 2010 (Badan Pusat Statistik Kabupaten Berau, 2010).

Based on report from Tandjung Redeb port, the District exported a large volume of coal (13.50 million metric tonnes) with an estimated value of IDR 5,346.90 billion. Other notable exported commodities are timber, pulp, crude palm oil (CPO), and general products. Estimated export values of those commodities are IDR 729.61 billion, IDR 389.27 billion, IDR 833.13 billion and IDR 0.48 million, respectively (see Table 2.3).

[9] The figures do not differentiate between trade with the rest of Indonesia and overseas.

Table 2.3. Volume and estimated values of exported commodities through Tanjungredeb Port of Berau, 2007

No	Commodities	Volume (1)	Unit	Estimated value (IDR million) (2)
	Timber products	*532,998.00*		*729,609.60*
1	Sawnwood	34,494.00	m3	68,988.00
2	Logs	425,892.00	m3	638,838.00
3	Woodchips	72,612.00	m3	21,783.60
4	Coal	13,502,262.00	tonnes	5,346,895.75
5	Pulp	57,670.00	tonnes	389,272.50
6	Crude Palm Oil	132,243.00	tonnes	833,130.90
7	Others	5,387.00	tonne/m3*	484.83

Source: Berau Dalam Angka, 2007.
Note:
- *) mixed between tonnage and volumetric unit; no information on type of products. It is assumed that the average value is IDR 1 million per unit.
- Other commodity values are estimated based on their 2007 spot prices, taken from variety of (internet) sources.

In 2007, total imports value of the District was IDR 8.89 billion. Table 2.4 illustrates major commodities imported, their volumes and estimated values, as reported from the Tanjungredeb Port in 2007. Products of gasoline and crude oil are the largest, totalling a value of IDR 1,644.6 billion. Other main imported commodities are acacia woods (wood chips), cements, rice and other products. Estimated values of those commodities are IDR 377.69 billion, IDR 248.23 billion, IDR 63.57 billion, and IDR 61.93 billion.

Table 2.4. Volume and estimated values of imported commodities through Tanjungredeb Port of Berau, 2007

No	Commodities	Volume (1)	Unit	Estimated value (IDR million) (2)
1	Gasoline	152,909.00	M3	899,487.19
2	Cement	36,022.00	tonnes	63,568.24
3	Sugar	961.00	tonnes	7,207.50
4	Rice	10,321.00	tonnes	61,926.00
5	Black Oil, used for machineries	31,666.00	tonnes	745,100.98
6	Acacia woods	1,888,392.00	M3	377,678.40
7	General products/others	248,225.00	tonne/m3*	248,225.00

Source: Berau Dalam Angka, 2007.

Note:
- *) mixed between tonnage and volumetric; no information available on type of products. It is assumed that the average value is IDR 1 million per unit.
- Other commodity values are estimated based on their 2007 spot prices, taken from variety of (internet) sources.

2.3.2 Berau Forest Carbon Programme (BFCP)

The Nature Conservancy (TNC) initiated the BFCP with national, provincial, district governments, civil society, and the private sector to demonstrate the application of the REDD concept at the district level (Berau District, East Kalimantan). The programme aims ‘to enable the district to meet its development goals while sustainably managing its forest by developing a carbon finance mechanism that delivers effective incentives to reduce emissions from forest loss (Ministry of Forestry Indonesia & The Nature Conservancy). This would be achieved through sustainably managing 800,000 ha forests, avoiding 10 million tonnes of CO2 emissions within five years, protecting areas that have both hydrological and biodiversity functions, including the habitat of 1,500 orangutan and providing better economic opportunities for forest-dependent communities (The Nature Conservancy, 2009).

The BFCP programme requires a total fund of US$ 50 million for five years and is now at the development stage, in which the proposed programme and relevant important issues (e.g. legal issues, participation of stakeholders) have been discussed with all stakeholders. The programmes are expected to be fully implemented in 2016 (Ministry of Forestry Indonesia, Berau District Government, East Kalimantan Province Government, & The Nature Conservancy, 2011).

Despite the fact that the Berau District has been successful in retaining its 75% of forest cover (The Nature Conservancy, 2009), its forests face threat from logging, both legal and illegal, conversion to oil palm (permits have already been granted on 87,037 hectares of primary and secondary forests for other allocation/APL classified lands), establishment of pulp and paper plantations, and coal mining. It is reported that planned and unplanned logging in the district has been extensive over the last 15 years[10]. The Berau Forest Carbon Program has formulated the following strategies to reduce emissions from deforestation and forest degradation:

Improving forest management within timber concessions

It is recorded that among 1.6 million hectares of Berau forests, 780,000 ha have been managed as natural production forests (under 11 logging companies) and 230,000 ha for plantation forests (under three companies). Therefore, sustainable forest management is critical as part of reducing emissions especially from forest degradation. So far, eight companies have been making efforts to improve their forest management by setting aside High Conservation Value Forests (HCVF)[11], adopting Reduced Impact Logging (RIL) techniques as well as timber tracking – a technique to enable tracing logs from their original forest block (Ministry of Forestry Indonesia & The Nature Conservancy). Applying reduced impact logging (RIL) techniques in harvesting may reduce 30% of carbon emissions due to avoiding destruction of other standing stocks during harvesting and logging process (Putz & Pinard, 1993).

Improving forest management within protection forests

Currently, there are 350,000 ha of protection forests in Berau District and there is a proposal to add 200,000 ha to make a total 550,000 ha of protection forests. The TNC assumed that the additional protection forests are derived from forests already allocated from oil palm plantation and substantially from natural protection forests/open access area. Improving the management of protection forests is important in reducing forest emissions since 14% of total Berau forest

[10] Proposal Draft of The Berau Forest Carbon Demonstration Program: A Laboratory to Support Development of a National Forest Carbon Program in Indonesia, The Nature Conservancy March 19, 2009

[11] High Conservation Value Forest was introduced by the FSC and defined 'as forests of outstanding and critical importance due to their high environmental, socio-economic, biodiversity or landscape values ".The concept expands from its original purpose as tool for certification to more general conservation planning. In practice, most HCVFs are managed outside protected areas, hence their approaches are varied.
http://wwf.ca/newsroom/reports/forests_freshwater/hcvf.cfm visited 14 November 2009

emissions between 1990 and 2005 com from protection forest areas (Jarvis, 2009). The Nature Conservancy is developing an approach of supportive policy development while also piloting incentive agreements with managers of protection forests. Another important feature of this effort is restoration of degraded and cleared land within protected forests (Ministry of Forestry Indonesia & The Nature Conservancy).

Redirecting oil palm development to degraded lands

The Nature Conservancy reports that among forest areas allocated for other purposes, 50% are still forested. For instance, 123,000 ha of 188,000 ha of forest areas designated for oil palm plantation establishment are still covered by forests. Regarding this, reducing emissions from forests could include a strategy to swap the oil palm establishment for already degraded lands. The program currently identifies suitable degraded land for oil palm plantations and seeks appropriate incentives for lost opportunities (Ministry of Forestry Indonesia & The Nature Conservancy).

Increasing the setting aside of protected forests within forests concessions

The Berau program also explores the potential to create a mechanism 'to reward' forest concessions which set aside their high carbon, high biodiversity or social value areas within their timber concessions. This idea was inspired by an example in the US, in which TNC buy development rights from private landowners through conservation easements (The Nature Conservancy, 2010)

Other incentives

The BFCP also seeks the implementation of some additional incentives in order to attract stakeholders to participate in the REDD process, including simplified regulation, as well as provision of market access to certified products.

In addition, the research framework linking BFCP, the forestry sector and the socio-economic impacts of REDD policies is presented in the following Figure 1:

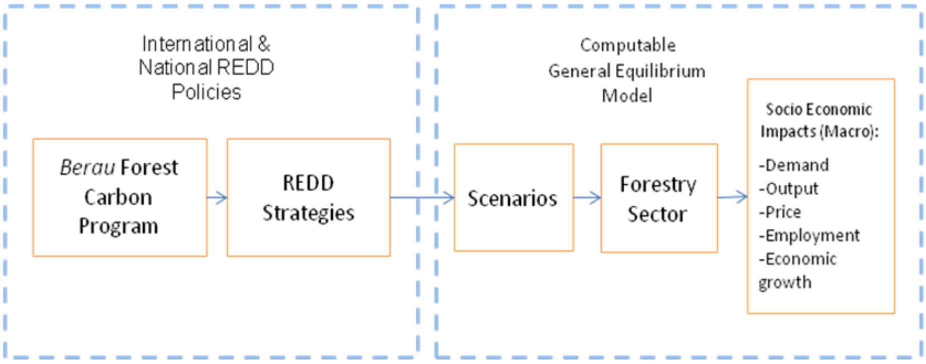


Figure 2.4 The research framework linking BFCP, forests and the socio-economic impacts of REDD

The Berau Forest Carbon Program (BFCP) attempts to demonstrate that REDD strategies could really work at the field level. The strategies formulated by BFCP, if successful should be under of interest to international and national policy on REDD.

The BFCP's set of strategies to reduce forests emissions affects the forests through people's behaviour i.e. how people treat and manage forests. For example, it is expected that forest conditions will be improved through improved-forest management and reduction of population pressure on the forests. These strategies and people's behaviour will be modelled within a CGE modelling framework.

The BFCP has potential socio-economic impacts on the regional economy. Using the CGE model, these socio-economic impacts of the BFCP will be assessed. Within the CGE Model, the BFCP's strategies affecting the forestry sector are translated into a series of scenarios. The results of the assessment will be presented in some changes of socio-economic indicators such as demand, output, price, employment and economic growth.

2.4 Conclusion

Indonesia suffers from deforestation and forest degradation at a relatively high rate. Deforestation and forest degradation drivers are very complex but they fall into planned and unplanned categories.

In accordance with the agreed mechanism of REDD+, the Government of Indonesia is committed to reduce emissions from deforestation and forest degradation. Several demonstration activities to reduce emissions from deforestation and forest degradation have been established, including the Berau Forest Carbon Program in Berau District, East Kalimantan Province, Indonesia.

Chapter 3 Literature Review of Computable General Equilibrium

This literature review provides a description of the computable general equilibrium (CGE) modelling and some applications involving the forestry-related policy analysis. Complement to this is a review on input-output and social accounting matrix table, which serve as database for the general equilibrium analysis.

3.1 Overview of Computable General Equilibrium

Partial equilibrium analysis is traditionally used as tool to assess demand, supply and market behaviour both at individual and aggregate levels considered in an isolation from other product or input markets (Perali, 2003). The World Bank suggests that partial equilibrium models are ‘best suited to analysing sector reforms that are less likely to have large impacts on macroeconomic aggregates[12]. However, in reality, a policy applied on a particular sector usually also affects other sectors and the overall economy . Furthermore, Vargas et al. (1999) note that because it is a model of a single market, the partial equilibrium analysis disregards potential effects in other markets. Hence, the partial equilibrium analysis ignores any terms-of-trade changes which may occur and this reflects its main weakness (Brown, 1987). In addition, it is encouraged to utilise a model that allows viewing many markets (of resources and commodities) simultaneously (Vargas et al., 1999).

A general equilibrium model is based on the Walrasian tradition which proposes that the allocation of resources in a market economy is a result of interaction between supply and demand leading to equilibrium in prices (Borges, 1986). The general equilibrium model provides a framework for analysing linkages between markets and thus interactions between industries, factor resources and institutions

[12] Impact Analysis: Partial Equilibrium Models. Available at http://go.worldbank.org/8DQD2SGFE0. visited 20 November 2011.

(Vargas et al., 1999). Moreover, general equilibrium analysis provides important insights into factors and mechanisms that determine relative prices and the allocation of resources within and between market economies (Bergman, Karl-Göran, & Vincent, 2005).

The general equilibrium model consists of a building block of equations representing the behaviour of relevant economic agents, e.g. consumers, producers, governments etc. Each of those economic agents either demands or supplies goods, services, and factors of production, as a function of prices. Assuming that market forces will lead to equilibrium between supply and demand, the general equilibrium model computes the prices that clear all markets, and determine the allocation of resources and the distribution of incomes that result in this equilibrium (Borges, 1986).

CGE utilises the microeconomic theory of production and consumption. Producers are assumed to operate at a level so as to optimise profit, which is defined as the difference between revenue and costs of factors and intermediate inputs, or minimise costs (Lofgren, Harris, Robinson, Thomas, & El-Said, 2002). Factors of production, i.e. labour, land and capital are assumed to be mobile and are all paid in accordance with their marginal products. Meanwhile, consumers are assumed to maximise utility subject to budget constraints.

CGE also utilises macroeconomic assumptions. An important assumption in the CGE is saving-investment balance. That is, savings should equal investments and it is generally assumed that the investments adjust automatically to the level of savings (Kraybill, 1996). Other choices of macroeconomic closure are government balance and external balance. For instance, in a government balance assumption, government savings, which is a margin between government revenues and expenditure, is a flexible residual while all tax rates are fixed. In external balance, the real exchange is flexible while foreign savings is fixed (Lofgren et al., 2002). San et al. (2000) suggest that ‘macro scenarios have different implications for the sectoral structure of demand, as well as the distribution income, as the regional adjusts to the macro shocks'.

In CGE analysis, a benchmark/initial condition of equilibrium is calculated from available data. A specific policy that is to be studied is then introduced into the model. Thus, the difference between the initial and final values of model variables or between the benchmark and a new (counterfactual) equilibrium is computed and is interpreted as the effect of the policy change (Kraybill, 1996).

There are not any specific rules to construct CGE models. However, the steps described below were followed in this research[13]:

- Compile the dataset, which may include an input-output and/or social accounting matrix;
- Specify structure of the model, including the number of activities/goods and factors, the number of consumers (e.g. households), countries (e.g. whether it is a single region model, two countries model or multi regions), and the number of active markets. The construction of CGE model structure depends upon the nature of the problem being analysed and data availability;
- Define functional forms that will be used. In this stage, modellers consider and select functional forms, for instance, Cobb-Douglas, Leontief or constant elasticity of substitution (CES) for production and utility functions. Modellers also define the nesting structure of production functions;
- Calibration and replication. Calibration is a process to finding unknown parameters (coefficients of preferences and technology) by retaining endogenous variables at the values in some known equilibrium observed in SAM table. Then replication run is carried out to see if model reproduces benchmark, that is the original dataset of SAM;
- Test the model and counterfactual. In this stage, counterfactual scenarios are designed; CGE is run and results are compared with benchmark;
- Report generation and interpretation of results.

[13] See for example: Peterson, S. 2003. CGE MODELS AND THEIR APPLICATION FOR CLIMATE
POLICY ANALYSIS. see http://users.ictp.it/~eee/workshops/smr1541/Peterson3.pdf; and Markusen & Light, M. 2004. A MPSGE User guide.
http://mileslight.com/armenia/MPSGE_users_guide.pdf

Choosing computable general equilibrium over input-output and SAM analysis

Economists consider the computable general equilibrium more realistic from the theoretical point of view compared with input-output and social accounting matrix analysis as a tool for policy and impact analysis. Input-output analysis assumes that sectoral production is demand-driven, and implying that there is always excess capacity in all sectors to meet the increased demand with no rising of prices (fixed price). This assumption is unrealistic, since increased demand for a certain product will lead to a price increase and change in the equilibrium quantity. The input-output analysis also utilises an assumption of a constant return to scale production function with no substitutions among different inputs (Vargas et al., 1999), while CGE models are able to capture the substitution possibilities between factors of production.

Briassoulis (1991), as cited by Dwyer et al. (2004), claims that the input-output analysis is of limited value because it provides an incomplete representation of the ways economies work. Partridge and Rickman (2010) state that ‘the implicit structure of input-output and social accounting matrix (SAM) models has been shown to bias regional impact and policy assessment’. They further state:

> “Because of their fixed-price and implicit perfectly elastic supply assumptions, input-output models are incapable of estimating the potential supply-induced displacement of other economic activity, which leads to overestimates of [the] net benefits … (Partridge & Rickman, 2010, p. 1312).

Citing from Sadoulet and de Janvry (1995), Vargas et al. (1999), argue that input-output analyses ‘are more useful as guidelines to potential induced linkage effects, and as indicators of likely bottlenecks that may occur in a growing economy, than as predictive models’.

Being an extension of an input-output table, a social accounting matrix analysis also has the same limitations similar. These are the assumption of fixed price, no factor of substitution in production and no commodity substitution in consumption. These restrictive assumptions suggest that the social accounting matrix also lacks a theoretical foundation (Batey & Rose, 1990; Vargas et al., 1999).

3.2 Application of CGE Analysis

CGE has been applied at the global or multi-country level, see e.g. Gan (2005) and Lemelin (2008), at national level (as a single nation or multi region within one nation model, see for example the work of Das et al. (2005), Pambudi and Smyth (2008) and Pambudi et al. (2009); and a single region (sub nation) model e.g Schreiner et al. (1996); and Bednarikova and Doucha (2009) as well as in Taylor et al. (1999). An extensive review of regional CGE models can be seen in Partridge and Rickman (1998).

CGE analysis was used by Shoven and Whalley (1984) to analyse policy issues regarding tax reform in US and international trade. Since then, the utilisation of the CGE in this area has been extensive. Bandara (1991) for example, extensively reviewed the application of CGE modelling to trade policy issues (such as import tariff application and trade liberalisation), income distribution issues (e.g. impact of policies to reduce poverty and income inequality), and external shock-related issues (e.g. impact of rising of oil prices or declining copper prices) in developing countries. De Melo (1998) also surveyed CGE models focusing on the impacts of trade policy issues in developing countries. Compared to Bandara (1991), his work emphasised simulations of trade policy reform. Decaluwe and Marthens (1988) surveyed CGE modelling in 26 developing countries and they emphasised their assessment of the CGE models with respect to the following:

- production block: detailed level of activities and different production function nesting;
- private consumption block: detail of consumer disaggregation and type utility function used e.g. the Geary-Stone/Linear Expenditure System;
- external trade block: Armington treatment and elasticity of transformation used in this block;
- type of macroeconomic closure; and

- nature and results of simulations.

More recently, CGE analysis has been utilised to study policies related to natural resources and forestry.

Persson (1994) studied the impacts of market failures and macro-economic policies on deforestation in Costa Rica. San et al. (2000) evaluated impacts of a structural adjustment program i.e. real devaluation on the agricultural sector including forestry in Sumatra, Indonesia. San et al. (2000), consider finance-related policies affecting agriculture, forestry and the process of deforestation. Rise of the deforestation, however, was concluded from an increasing demand for forestry products, both as final goods and intermediate commodities for the wood processing industry. Cattaneo (2001 and 2005) worked on the impacts of macroeconomic adjustments caused by devaluation, changes in transportation costs and technical change on deforestation and agriculture in Brazil.

Percy (1988) developed a CGE model for Indonesia called INDOTIM 2.0 (which is based on ORANI, a CGE model developed by Horridge (2003)) to evaluate the short-term impact of the rapid growth of Indonesian forestry during the 1990s (Percy, 1988). Zhang et al. (2005) studied the impacts of closing national forests for timber production in Florida and Liberty County in US. Gan (2005) assessed the potential impacts of forest certification costs on global forest products markets and trade. Das et al. (2005) modelled the effect of environmental regulations and technical change in the US forestry sector. Alavalapati et al. (1998) simulated the impacts of land use restriction for agriculture, forestry and energy sectors in Alberta and British Columbia. Dufournaud et al. (2000) also applied the CGE method to simulate the effect of different forestry policies in Vietnam such as a log-export ban, an increase in ad valorem taxes and an increase in log export taxes on the Vietnamese economy. Stenberg and Siriwardana (2007) assessed the economy-wide impact of strategies to enhance forest conservation in the Philippines, while Banerjee and Alavalapati (2009a) simulated the economic impacts of establishment of 13 million hectares of forest concession on public lands in Brazil. They extended their work to analyse further impacts of forest concession establishment on illegal deforestation and illegal forestry activities (Banerjee & Alavalapati, 2009b).

In addition, Stenberg and Siriwana (2005) reviewed recent developments of the application of CGE modelling to analyse deforestation and forestry policy issues. They pointed out that most CGE models used for forestry analysis were static and suggested that incorporating dynamic equations in capital formation will improve the usefulness of the CGE model. The authors suggested that due to early stages of its utilisation, there are more opportunities for innovation and improvement in the utilisation of CGE analysis for forestry-related policy.

3.3 Regional CGE Analysis

According to Partridge and Rickman (1998), a most likely reason for the relative slow start of regional CGE modelling, compared to national or global models, is the lack of data availability at the sub national or regional level. Recently more techniques to generate regional accounts (particularly input-output tables) have been developed, which further advances the use and its acceptability of CGE for regional analysis. Procedures to estimate regional input-output tables as the database for CGE analysis have been developed (see sub section 3.5.2) – for example GRITs (Generation of Regional Input-Output Tables) in Australia (West, 1990) and IMPLAN[14] in USA.

The application of CGE analysis at regional levels may differ from national applications, because regions are relatively more open economies than entire nations. At this level, commodity trade and resource (factors of production) migration may be more important, e.g. they will likely have significant impact on the region (Kraybill, 1996; Vargas et al., 1999). For instance, if other regions offer higher rates of return, households and investors would not invest within the analysed region. Therefore, compared to a national CGE model which requires an

[14] The IMPLAN System. Available at http://implan.com/V4/index.php?option=com_content&view=article&id=346:fp2&catid=172:fp1. visited 2011

assumption of balance between saving and investment, a regional CGE model allows an assumption of excess savings to flow out of or into regions. Most regional CGE model, however, rely on specification common to the national CGE model (Vargas et al., 1999).

Partridge and Rickman (2010) point out that most regional CGE models are made in accordance with national or international CGE models. That is, the institutional details, product market structure, closures and cross-economy interactions contained in CGE models reflect the national or international economic structure. They further suggest that regional CGE models should reflect regional development economic theory. Furthermore, it is recommended that the regional CGE model should be built under a multi-region specification, rather than a single region model, and as dynamic model instead of static one (Partridge & Rickman, 2010)[15.]

Holland (2010) discusses some differences in macro-economic behaviour at a regional level compared to those of national macro-economic behaviour. He concludes that further caution should be taken by not applying conventions from a national CGE model when constructing a regional one. For example, a regional model should be described by lower elasticity of substitution and higher elasticity of transformation that those of national CGE model. In US, because many exports are destined for national markets, such products seem likely to be nearly similar or identical to the products sold in the regional markets. This suggests that there is lower product differentiation for traded commodities at the regional than at the national level. Consequently, regional sectors find it relatively easy to substitute between regional and national export markets.

[15] Data limitation avoids the construction of a multi-regional type CGE model of Berau District. INDORANI, an Indonesian multi-provinces CGE model used by Pambudi (2008) has inter-provinces data or the Analysing PATH Programme uses a multiregional CGE model which is employing the inter-island SAM table of Indonesia. However, the Berau SAM/CGE model reflects the characteristic of regional structure that is rich of tranfers (e.g. between ROW and factors, ROW and institutions and ROW and investments).

This will be indicated by a relatively high elasticity of transformation. The case is different regarding elasticity of substitution between imported and locally produced commodities. Again in US, in most commodities, regions are characterised by less variety in locally-produced commodities than ‘would characterise imports from the national economy’. This suggest that locally produced commodities are imperfect substitutes for imported products and at the regional level, relatively large changes domestic products prices relative to imported products will not likely affect the level of import for the commodity. This further implies that regional CGE model is expected to exhibit lower elasticity of substitution estimates compared to national economics. Hence it is suggested that adopting national elasticities will likely be incorrect for modelling regional trade behaviour (Holland, 2010)[16]. Despite this caution, however, most regional CGE models have a similar specification to the corresponding national CGE model (Vargas et al., 1999).

Regional CGE modelling has been applied to assist local decision makers analyse policies that impact on job provision and income generation (Loveridge, 2004). It has also been used for policy analyses related to agriculture, environment and natural resources, fiscal, and transportation (Partridge & Rickman, 1998). Schreiner et al. (1996) discussed the application of regional CGE for analysing the impacts rural development programme on households welfare in Oklahoma. Bednarikova and Doucha (2009) analysed the impacts of different agricultural policy scenarios on the development of rural areas of Bruntal and Ostrava Districts in the Czech Republic. Taylor et al. (1999) modelled the impacts of agricultural policy reforms on production, incomes and migration in a village-town economy in Mexico. CGE has also been employed to measure the economic impact of providing direct compensation to farmers due to water use restrictions in rural Nevada and California, USA (Seung, Harris, MacDiarmid, & Shaw, 1998).

[16] Sensitivity analysis with regard to a CES parameter in agricultural activities is tested, see Chapter 11

3.4 Potential use of CGE Analysis to analyse REDD+ policies

REDD+ policies are implemented to reduce deforestation and forest degradation as a cause of greenhouse gas emissions. However, the drivers of deforestation and forest degradation are very complex, with land use change, poverty, land tenures, governance, and illegal logging as contributing factors.

Although there have been many application of CGE analysis in forestry sector, its application to modelling policies to reduce deforestation and forest degradation is quite recent. The closest model relating to forestry (and hence REDD+) using CGE analysis is the framework by Dee (1991) which is later adapted by Thiele (1993, 1994, 1995) and Stenberg & Siriwardana (2009; 2007). They incorporate a sub-forestry production function which incorporates a growth function. Using the sub-forestry production function, modellers are able to view beyond the usual economic impacts to such factors as adjustment in the rotation age, the volume of timber per hectare per rotation and the area of land devoted to forestry (Thiele, 1994).

In addition, possible approaches to utilising CGE model to analyse REDD+ policy are the following:

1) REDD+ policy requires timber companies to adhere to environmental standards such as reduced-impact logging (RIL) or forest certification (e.g. this is embedded in the project in Berau Forest Carbon Programme). This type of policy may be modelled in CGE as an addition (or increase) of environmental costs, as in the work Das et al. (2005);
2) Improving forest management can be captured as an increase in the level of investment as in the work of Thiele (1995);
3) The core idea of the REDD+ policy involves transferring compensating payments to involved institutions such as forestry-dependent communities or households which are directly affected by REDD+ as in the case of Noel Kempff in Bolivia (Couto Pereira, 2010). In the literature, there exist some

CGE models that incorporate compensating targeted households such as the work of Seung et al. (1998), and Thiele (1995) ;

4) To reduce emissions from deforestation and forest degradation, policy makers may introduce ‘a carbon tax’. For instance, in forestry sector, this may be approached by applying carbon tax per timber output. The potential impact of introducing such tax in Brazil has been assessed by Cattaneo (2002).

3.5 Data and data organisation

CGE models require intensive data (Kraybill, 1996; Vargas et al., 1999). The data are identified and organised into a social accounting matrix (SAM) and/or input-output (IO) tables (Vargas et al., 1999). What follows is a general overview of a social accounting matrix, which including its construction and application. Since the backbone of a social accounting matrix table is an input-output table, an overview of the input-output table will also be presented. In addition to the input-output and SAM tables, the CGE also utilises econometrically-estimated parameters that can be derived from analysis or previous studies (Bednarikova & Doucha, 2009; Vargas et al., 1999).

The social accounting matrix table, an extension of the input-output table, is a presentation of national accounts in a matrix format. The (social) national accounts (often referred as macroeconomic accounts) aim to provide a representation of economic behaviour which includes production/output, consumption/expenditure, accumulation and the associated concepts of income and wealth, as well as their simplified interrelations (European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, & World Bank, 2009).

3.5.1 Input-Output Table

A. Overview of Input-Output Table

Wassily Leontief first developed an input-output framework in the 1930s. The input-output framework describes the flows of value of goods and services between all the individual sectors of the national economy over a certain period (e.g. usually for a year). The input-output table represents a subset of the SAM and comprises activities and commodities accounts only. Properties of the input-output table will be discussed in Chapter 5 as part of describing a method to construct input-output and social accounting matrix tables.

Input-output analysis has been traditionally used for regional policy analysis. The tool is usually employed to assess the potential impacts of the final demand change on the producing sectors of the economy. For instance, Belegri-Roboli et al. (2007) assess the potential diffusion effect of labour productivity due to change in final demand of some industries. Ciaschini and Socci (2007) demonstrate the relationship between final demand and output of industries in Spain. Applications of input-output analysis in forestry include the work of Dhubhain et al. (2009), who employed input-output analysis to evaluate the direct, indirect, and induced impact of the forestry sector and wood-based industry on the Irish economy, including a scenario of afforestation. Psaltopaulus and Thompson (1993) evaluated the role of forestry in the rural economy of Scotland. In their analysis, they generated a regional input-output table, and utilised multiplier analysis[17] emphasising the forestry sector. Input-output was utilised to evaluate the inter-industry linkages in Wales, for strategic planning purposes (Midmore, Munday, & Roberts, 2006), and Munday and Roberts (2006) analysed the economic contribution of the forestry sector to inform policy directionin Wales. In Indonesia, input-output was used to analyse a forestry policy of reducing annual harvesting allowance in East Kutai District, East Kalimantan (Pusat Rencana Kehutanan Departemen Kehutanan & Direktorat Neraca Konsumsi Badan Pusat Statistik, 2001), and to analyse the forestry sector‘s role in Indonesia (Ulya and Yunardi, 2002).

B. Constructing an input-output table at a regional level

[17] Note that the basic approach of SAM multiplier analysis is to compute column shares (column coefficients) in order to represent structure, and as in the input-output analysis, to compute matrix multipliers. For this multiplier analysis, see e.g. Thorbecke & Babcock (2000) and Round, J.I. (2001).

Official input-output tables are usually constructed based on a survey of a representative institution (Kronenberg, 2007a; West, 1990). In developing countries funding and expertise are quite scarce; this type of publication is rarely available[18]. Consequently, input-output researchers attempted to construct a regional input-output table by utilising national data; a process that regionalises a national input-output table[19] (see Figure 3.1.). In addition, two extreme approaches to construct a regional input-output table are a full non-survey method (which is very expensive but has high accuracy) and a pure non-survey methods (which is less expensive but relatively less accurate (Kronenberg, 2009; West, 1990)); while a combination of those techniques is a compromised-approach.

It is likely that the first attempt of producing regional input-output table was the work of Hewings (1969), who estimated a West Midlands input-output table from the UK input-output table. Since then, researchers have developed the techniques to generate regional input-output tables. For instance, Stevens et al. (1983) proposed using the "Regional Purchase Coefficient"[20] to develop a non-survey-based input-output table. West (1990) used the GRIT method to produce a regional input-output table in Australia. Examples of more recent work are Jackson (1998) and Kronenberg (2007a, 2007b, 2009). Jackson (1998) proposed to regionalise a national input-output table to produce regional accounts, and this method has been further elaborated and elucidated by Lahr (2001). Meanwhile, Kronenberg (2007a, 2007b, 2009) in the latest method proposed to improve the commodity balance approach by taking into account a phenomenon called cross hauling, which is defined as a simultaneous export and import of the same commodity. A review of approaches to constructing the non-survey input-output table can be found in Richardson (1985) and Lahr (1993).

[18] The proposed study location i.e. the Berau District provides a typical situation where a recent input-output table is absent and consequently, an estimate of its input-output and SAM tables must be constructed from other information.

[19] The term 'regionalisation' can actually refer to a process of deriving regional accounts from national accounts or in this case from provincial accounts to district accounts.

[20] The Regional Purchase Coefficient (RPC) is the proportion of regional demand fulfilled from regional production. It is based on substitution between extra and intra-regional sources in response to delivered costs.

In addition, the literature provides an array of approaches on how to generate a regional input-output table by utilising national information (i.e. non-survey based-methods). Among available techniques, most popular ones are:

a. *Location Quotient technique*

LQ methods[21] are based on the assumption that the relationship between regional input-output coefficient $a_{i,j}^{R}$ and its national counterpart $a_{i,j}^{N}$ can be described as follows:

$$a_{i,j}^{R} = t_{i,j} a_{i,j}^{N}$$

The term $t_{i,j}$ can be interpreted as a ''trading coefficient'' (Round 1983) or a ''regional purchase coefficient'' (Stevens et al. 1983) and it can be estimated using various ways. In the Simple LQ method, the term $t_{i,j}$ can be calculated by using a location quotient LQ_i for each industry i and using it as a proxy for $t_{i,j}$. The LQ_i is defined as:

$$LQ_i = \frac{L_i^R}{\overline{L}_i^R} / \frac{L_i^N}{\overline{L}_i^N}$$

where $\overline{L}_i^R$ denotes total employment in the region, $\overline{L}_i^N$ denotes total employment in the nation, and the subscript *i* refers to a particular activity or industry *i*. Assuming equal labour productivity, LQ_i can point out whether an activity *i* is 'overrepresented'' or ''underrepresented.'' If LQ_i is smaller than one, hence '' (Schaffer and Chu 1969, p. 86). The LQ_i is then substituted for $t_{i,j}$ so $a_{i,j}^{R}$ will be smaller than $a_{i,j}^{N}$. On the other hand, a location quotient equal to one suggests that the region is self-sufficient, while a location quotient value greater than one indicates that the region exports some of its output *i* (Schaffer & Chu, 1969).

[21] It was initially exercised to use the LQ approached but the result was less satisfactory.

Adapting from the simple LQ method, researchers developed other various techniques in estimating the term $t_{i,j}$. For example, Morrison and Smith (1974) constructed an input-output table for the City of Peterborough, England, using the simple LQ and various modification of the LQ techniques. Round (1983) suggests a term 'trading coefficient' as a proxy to the term $t_{i,j}$. Stevens et al. (1983) proposed 'a regional purchase quotient' to estimate the trading coefficient.

b. *Commodity balance approach or supply demand*

Isard (1953) introduces the term of commodity balance and his work on regionalisation input-output table provides a base for the commodity balance or supply demand approach. The commodity balance or net export *b* is defined as the difference between exports *e* and imports *m* and mathematically presented as:

$$b = e - m$$

Note that the commodity balance is further discussed in section 5.2.2 of Chapter 5.

The commodity balance approach, however, is criticised not to produce a complete regional input-output table because the table misses trade (exports and imports) figures. That is, it only provides an estimate of net exports. Citing from Moore and Peterson (1955), Kronenberg (2009) explained that some modellers simply resolve this problem assuming that if net export is positive, import equals zero, hence export equals the commodity balance; meaning that the region is self-sufficient and able to export some of its domestic production. If net export is negative, export is assumed to equal zero and import equals the commodity balance; meaning that the region requires import to meet demand. In reality, this is not necessarily true since a region can import a commodity to fulfil its demand while at the same time the similar locally produced good is exported.

c. *Iteration method or RAS approach*

The RAS method is basically a process to update a past input-output table into a current one. It employs information of present total input or output (i.e. row and column sums) of the input-output table of the present year. The RAS method consists of finding a set of multipliers to adjust the rows of the existing matrix and a set of multipliers to adjust the columns so that the cells in the adjusted matrix will sum up to the required row and column totals relating to the later current year. In mathematical terms, if A_0 is the coefficient matrix corresponding to the benchmark input-output matrix F_0 table and A_1 is the updated matrix of input output coefficients corresponding to the estimated input-output matrix F_1,:

$$A_1 .\hat{r} A_0 \hat{s}$$

where *r* and *s* are row and column multipliers, and ˆ represents a matrix. The process is carried out iteratively until the sum of row of the matrix equals the sum of the corresponding columns. For further description of the RAS method, see Richardson (1985) and Department for Economic and Social Affairs Statistic Division (1999).

Among those methods, the iteration or RAS method and the econometric approaches still require an amount of data. Therefore, only the location quotient and the commodity balance methods can be considered as ‘true’ non survey methods (Lahr, 1993).

Lahr (2001) summarised some principles that have been used during the development of regional accounts either by using a small amount of data or pure non-survey methods as follows:

a. When deriving regional accounts from national accounts, use as much sectoral detail as there is available. This has also been suggested by Morrison and Smith (1974).
b. Regionalisation requires an assumption that technology is spatially similar within a region $a_{i,j}^{R} = a_{i,j}^{N}$; an assumption that has also been widely used by

most input-output modellers (Hewings, 1985, p. 40; Richardson, 1985). Lahr (2001) further suggests that some adjustments -- e.g. in a regional level a sector is more labour intensive compared to that of national level -- could be made if considered necessary.

c. Regionalisation typically should be carried out on utilising information of national accounts. Lahr (2001) states that most regionalisation methods fail to account for regional exports and imports, as in the case of supply/demand pool technique. Therefore, he suggests that regionalisation methods must utilise any information of national technology.

C. Concerning the accuracy of the non-survey based input-output table

Following the initial attempt to estimate an input-output table by Hewing (1969), techniques to construct an input-output table based on non-survey methods have been widely developed. This has evolved into the development of a commercially available ready-made model of an input-output table (Jensen, 1990). Following this development, critical questions emerged regarding the accuracy and reliability of the predicted input-output table.

Jensen (1980) introduces two types of accuracy i.e. partitive accuracy and holistic accuracy with regard to constructing and validating a regional input-output table. The partitive accuracy is described as the accuracy of predicted input-output table which are built upon a compilation of accurately-calculated-information of cells of the input-output table. Hence, the accuracy focuses on the cells of the table and depends on the cell accuracy in the statistical sense. Assuming that each cell records a true and accurate transaction, the table then reflects the true table with a high degree of accuracy (Jensen, 1980).

On the other hand, holistic accuracy is defined as the accuracy of the predicted input-output table in mathematically portraying an economy as a whole. Thus, it does not focus on cells of the tables 'but on the accuracy with which the table represents the main features of the economy in a descriptive sense' and retains these features' importance in an analytical sense (Jensen, 1980, p.142). The table underlines the main features of the economy in terms of size and structure, and less-analytically important features are treated as background. In this sense, partitive accuracy will ensure that the table is holistically accurate, but holistic accuracy does not necessarily come with a high degree of partitive accuracy, particularly with respect to the less significant parts of the table (Jensen, 1980).

Partitive accuracy is considered inappropriate as a general approach to regional input-output tables because it is very expensive to achieve (Jensen, 1980). He suggests that the construction of a non-survey input-output table should be directed to achieve accuracy in the holistic manner, according to his statement:

> "The more modest goal of holistic accuracy is appropriate to regional input-output tables. In these terms the accuracy...would be judged, not on the accuracy of its separate parts, but on its ability to represent the size and structure of the economy in general terms" (Jensen, 1980, p.143).

Jensen (1990) further points out that non-survey input-output development can only be legitimised by an acceptable theoretical/logical structure. To increase the accuracy and acceptability of the input-output table, integrating all exogenous available information with the employed methods is advised (Bonfiglio, 2005).

Some modellers attempted to evaluate the accuracy of an input-output table constructed using non-survey data by comparing it with its counterpart produced from a survey. Bonfiglio (2005), for instance, evaluated the performance of non-survey methods (seven derivates of location quotient methods and a supply-/demand pool method) by reproducing a survey-based input-output model in both a partitive and holistic sense. He concluded that the examined non-survey methods produced better results in estimating multipliers than input-output coefficients.

According to Round (1983), as cited by Kronenberg (2009, p. 42), "…nonsurvey regionalization methods do not produce estimates in the statistical sense but rather 'surrogate'"…. This is in line with Morrison and Smith's (1974, p. 13) statement that "the non-survey can only produce an approximation of a full survey-based table".

The construction of the input-output table and social accounting matrix for the study location will adhere the holistic type of accuracy in light that it will represent the structure of the region's economy. Following Lahr (1993), Kraybill (1996), this is to be achieved through:

- identification and collection of superior data; required to be inserted into the relevant cells or matrix of the table (Lahr, 1993);
- identification of key sectors (Lahr, 1993); what sectors contribute most to the economy of the region and whether they are natural resources-based sectors or service sectors;
- Comparison and review with national /and neighbouring accounts; this stage is required to estimate cells or information that are not available for in the region. Usually this is done by national/local experts or statisticians
- Provision of export judgments; involving consultation process with national and regional statistic office. This to adjust or modify cells or information that is too big or illogical regarding the region.

3.5.2 Commodity Balance with Cross-Hauling Approach

To construct a regional input-output table, Kronenberg proposes a technique called the Commodity Balance with Cross-Hauling Approach, because it is based on the commodity balance / supply demand pool approach (Kronenberg, 2007, 2009a, 2009b). He improves the traditional approach by adding a method to estimate a regional trade figures i.e. imports and exports. The traditional commodity balance approach, however, only estimates net exports (exports minus imports). As a result, the commodity balance approach does not create a complete regional input-output table due to the absence of trade data. Citing from Moore and Peterson (1955), Kronenberg (2009) explained that some modellers resolve this problem by assuming that if net export is positive, import equals zero, hence export equals the commodity balance. If net export is negative, export is assumed to equal zero and import equals the commodity balance.

Kronenberg (2009) further argues that the assumption is problematic since in reality, 'cross hauling', which is defined as a phenomenon of simultaneous exporting and importing of a given commodity, frequently occurred. In addition, his improvement towards commodity balance approach also lies in the inclusion of a particular theoretical foundation related to trade figures' estimation.

The notion of cross-hauling is expressed by Richardson (1985) and Jackson (1998). As Jackson (1998, p. 234) puts it:

> "the treatment of imports…. implies that no cross-hauling takes place… Assuming no cross-hauling … underestimates gross imports and exports from other regions".

Robison and Miller (1988) also observed the phenomenon of cross hauling in the timber sector when constructing a non-survey input-output table for a small area. Norcliffe (1983) indicated that cross-hauling happened due to product differentiation and consumer's preferences. Kronenberg (2009), stated that cross hauling occurs because commodity/products are heterogeneous. For example, a region might export automobiles since it produces automobiles, but still import automobiles from outside from consumer preference for that brand of automobile. In other cases, the cross hauling phenomenon in the timber sector is important for a small economy. Ignoring that phenomenon might cause overstated multipliers (Robison & Miller, 1988).

Kronenberg (2009), from Richardson (1985) insisted that failure to take account of the cross hauling causes an underestimation of regional trade and thereby leads to overestimated regional multipliers.

Since input-output analysis requires an assumption of a homogeneous product/commodity within a sector, the cross-hauling due to product heterogeneity violates this fundamental assumption. Citing Isserman (1990), Kronenberg (2009) suggests that the problem of cross-hauling can be reduced by employing data at a more detailed level of disaggregation, because at the detailed level, a commodity of the same group is relatively homogeneous. The use of as high an aggregation level as possible when carrying out regionalisation of national accounts has also been suggested by Lahr (2001) and Hewings (1974), although they do not relate this to cross hauling nor product heterogeneity.

There are two possible causes of cross hauling: (1) data only available at a more aggregate level. For instance, in the German National Input-Output Table, which contains no more than seventy-one sectors, cross hauling still exists, particularly in sectors such as clothing and machines and (2) proximity to borders where some industries receive supplies from outside. This is more likely to occur in a smaller area, especially where larger parts of the area are close to the border. Avoiding cross hauling by detailing sectors/industries into sufficient levels of detail could never be possible since products from different regions or countries cannot be perfect substitutes (Kronenberg, 2009).

Kronenberg (2007) demonstrates the development of a regional input-output table from a nation-wide input-output table. This approach employs a minimum data requirement such as regional employment quotients[22] to derive the regional matrix of inter-industry transactions, utilisation of regional trade, and its independence from subjective educated guesses (Kronenberg, 2007a). Furthermore, Lahr (2001) suggested using superior data e.g. information on primary inputs/value added such as labour income or expenditure if available. This approach has been applied to develop regional input-output tables in Germany and Northern Ireland (D'Elia, 2008; Kronenberg, 2007a).

3.5.3 Social Accounting Matrix

A. Overview of Social Accounting Matrix

A social accounting matrix for the accounting of an economic activity was originally derived from the work of F. Quesnay's "tableau economique" in 1756, which was later adapted by Leontief in constructing input-output of the US in 1941 (Eltis, 1975). According to Santos (2006), although Sir Richard Stone pioneered the development of the SAM framework, it was first described by Pyatt and Thorbecke in 1976. Later, SAM analysis became popular as a tool for

[22] The ratio between employment levels in a region (district) and in the nation (province) as a whole in each sector.

economic analysis, following the publication of the detailed development of a SAM for Sri Lanka by Pyatt and Roe in 1977.

According to King (1985), the objectives of the SAM are twofold i.e. to organise information about the economy and social structure of a country, region of a country, city or other geographical unit of analysis, in a particular year and to provide a statistical basis for the creation of a reasonable model. Hence, the social accounting matrix can be considered as a working tool for quantifying the flows in the whole economy and for simulating the effects derived from any changes in such flows (Santos, 2006).

A social accounting matrix is defined as a square matrix consisting of a series of accounts which describes flows between agents of commodity and factor markets and institutions. The matrix is a double-entry book-keeping system which is capable of tracing monetary flows through debits and credits and is constructed in a way that expenditure (identified as columns) and receipts (represented as rows) are equal (Vargas et al., 1999).

A social accounting matrix is characterised by three common features. Firstly, transactions in a particular year are presented in a matrix format, showing receipts in the rows and payments in the column (Keuning & Deruijter, 1988). These transactions are shown in the cells, thus the matrix depicts the interconnections between economic agents in an explicit way. Secondly, the SAM is also comprehensive in that it pictures the economic activities of the system including consumption, production, accumulation and distribution. Thirdly, the SAM is considered flexible that is, despite it always is set up in a standard format, 'there is a large measure of flexibility both in the degree of disaggregation and in the emphasis placed on different parts of the economic system'(J. I. Round, 2001).

As an economic tool, the social accounting matrix has been utilised to analyse issues of economic structure and impact assessment (Vargas et al., 1999) and its application ranges from at both national and local level, see for example Kinlen (2003) and Leeuwen and Nijkamp (2009). The use of the social accounting matrix analysis ranges from studying income distribution and redistribution, regional development, growth strategies in developing countries, decomposition of activity multipliers that shed light on the economy which comprises the circular flow of income, as well as a combination of social, technological/ environmental and economic issues (Santos, 2006).

There have been ample applications of SAM analysis, not limited to the forestry situation, available in the literature. For example, Hartono and Resosudarmo (2008) used the SAM method to estimate the impacts of controlling energy consumption by households in Indonesia. Psaltopoulos et al. (2004) utilised the method to model the impacts of three policy scenarios on regions in the EU. Psaltopoulos et al. (2006), again utilised SAM analysis to evaluate the inter-regional impacts of CAP measures such as farm income support, aid to increase agricultural productivity, and aid for economic diversification in Greece.

There have also been some applications in the natural resources and forestry situation. Marcouiller et al. (1993) developed and used a social accounting matrix to analyse the impacts of forest management. The social accounting matrix was used to analyse alternative economic development strategies in the Kickapoo River Valley in Southwestern Wisconsin. The study simulated increased production in agricultural production, agricultural processing, forestry production and processing, and tourism and analysed the impact on local income (Leatherman & Marcouiller, 1999). In Indonesia, a SAM has been used to analyse the impacts of forestry policy in the East Kutai District, East Kalimantan Province (Pusat Rencana Kehutanan Departemen Kehutanan & Direktorat Neraca Konsumsi Badan Pusat Statistik, 2001). Justianto (2005) utilised SAM analysis to evaluate the impacts of policies on forestry sectors on poverty in East Kalimantan Indonesia. For the purpose of his study, the household accounts (especially related to the forestry sector) are disaggregated into low income households (below the poverty line) and higher income (above the poverty line). Socia Prihawanto (1998) also used the SAM framework to analyse the effect of forestry policy on deforestation in Indonesia.

B. Constructing Social Accounting Matrix Table

The three major data blocks which comprise a SAM table are an input-output table, factor income data, and flow of funds data (Goce-Dakila & Dakila Jr., 2004). These data are usually available from a national or regional statistics office. Keuning and De Ruijter (1988) provide a comprehensive guideline to construct a social accounting matrix table. Yusuf (2006) also explains the construction of an Indonesian national SAM, in which his construction put an emphasises on the very detailed sectoral disaggregation (181 sectors/commodities) and households disaggregation into 200 types of households based on income and expenditure size.

Goce-Dakila and Dakila Jr. (2004) suggested that a small model in terms of level of disaggregation of production sectors, factors of production and homogenous households grouping be considered when constructing a regional SAM. The purpose is 'to test, whether top-bottom derivation[23] of cell entries in the regional SAM results in intuitively acceptable results'. From this point, it is possible to increase the disaggregation of sectors and households (Goce-Dakila & Dakila Jr., 2004).

In summary, some steps in constructing a SAM, as summarised from Keuning and De Ruijter (1988), Vargas et al. (1999), Goce-Dakila and Dakila Jr. (2004), and Yusuf (2006), are as follows:

a. Prepare data and information. This includes an official IO table containing information on industry production, inter-industry transactions, final demands, factors of production and imports/exports, and other relevant data. Yusuf (2006) suggests that for Indonesia, this should include SUSENAS[24] core module for individual observations, SUSENAS consumption module for

[23] Top-bottom approach uses a national SAM to derive a regional SAM; while a bottom up approach considers that regional SAMs would add up as a national SAM.
[24] SUSENAS stands for *Survei Sosial Ekonomi Nasional*, or National Socio Economic Survey, for constructing the Indonesian IO/SAM Table (Yusuf, 2006).

household expenditure observation, SUSENAS income module for household observations.

b. Transfer information from input-output table into SAM table. The information transferred includes intermediate (domestic and imported) input matrix, make/use matrix information, labour payment by industries, final demand (domestic and imported), tariff on imported commodities (if any) and ROW receipts.

c. Detail SAM account according to the purpose of study. This may include disaggregating activities (e.g. if the study emphasises production side of the economy), factor payments and household expenditure and income (e.g. if the study emphasises the distributive impact of particular policy). For example, Marcouiller et al. (1995) detailed SAM accounts i.e. factor accounts (e.g. labour into management /professional, technician/sales/administrative, service, farm/forest/fish, production/crafts/repair), forestry institutions (e.g. non-industrial private forestry, industrial private forest, public forest and wood processing) and non-forestry complex (e.g. agriculture and non-agriculture)) and households (into low-medium, high) when assessing the impacts of timber production and processing on different household income groups in Mc Curtain County, Oklahoma and Lake States (Marcouiller, 1995; Marcouiller & Stier, 2005).

d. Final reconciliation and balancing. Yusuf (2006) stated that this involves adjustments in minor imbalances in SAM. For example, when developing a national SAM, Yusuf (2006) revealed that imbalances occur in commodity accounts (between demand and supply) and factor accounts (between labour supplied and demanded by industries). He then utilised a programme such as SAMBAL (SAM balancing), a GEMPACK program developed by Horridge (2003) to solve this problem. Some popular techniques for balancing the SAM account include the RAS method[25], Least Square minimisation technique[26]

[25] http://www.adb.org/statistics/icp/files/6483-2DRW/RAS-Method-Capilit.pdf

(Fofana, Lemelin, & Cockburn, 2005) or the cross entropy approach (Robinson, Cattaneo, & El-Said, 1998; Robinson & El-Said, 2000).

In developing countries or regions in the developing countries, such social accounting matrix tables and other data are rarely available. Therefore, the data should be estimated using national or adjacent information as a proxy. CGE analysis that employs data generated from such estimation may still provide useful results (Kraybill, 1996).

3.5.4 Other parameters required by the CGE

Beside SAM and IO tables, CGE modelling also requires other exogenous parameters. These include the capital-labour share, and ratio of primary to intermediate inputs, as well as elasticities of substitution between primary inputs (labour, capital, and other resources e.g. land), elasticities of substitution between imported and locally produced goods (Armington elasticity), and elasticities of transformation between locally marketed and exported goods. These parameters can be obtained either from previous CGE models, literature or experts' estimates (Bednarikova & Doucha, 2009; Kraybill, 1996; Lus Centeno Stenberg & Siriwardana, 2005). For a dynamic CGE model, more information/parameters are required such as historical GRP, labour growth, the real interest rate and real depreciation rates.

[26] See for example the case of balancing the Social Accounting Matrix of Tanzania, http://www.mpsge.org/tza/tzabal.htm

Chapter 4 Methodology of Computable General Equilibrium

The chapter presents the central modelling methodology used in this research, that is, the computable general equilibrium model. The model of economic equilibrium, cast as a mixed complementarity problem is presented in section 4.2. The subsequent sections describe the core of static CGE model of the Berau District, including flow of goods and services in the CGE model (section 4.2) and the functional forms used (section 4.3). Section 4.3 presents dynamisation parameters that are used to extend the static model into a recursive dynamic one.

4.1. General Equilibrium Model as Mixed Complementarity Problem (MCP)

A general equilibrium problem can be formulated as a mixed complementarity (MCP) problem (Böhringer, Rutherford, & Wiegard, 2003), which reflects the fact that the formulation incorporate mixtures of equations and inequalities (Rutherford, 1999). Rutherford (1999) states that the MCP accommodate a variety of economic models that are not optimisation problems. For such problems, computational evidence suggests that algorithms for solving MCPs are relatively reliable and efficient.

Citing from Mathiesen (1985), Böhringer et al. (2003), suggest that the endogenous variables of the Arrow-Debreu economy can be classified into three categories:

- ***p*** (prices), which is defined as a non-negative *n*-vector of commodity prices including all final goods, intermediate goods, and primary factors of production,
- ***y*** (activity levels/quantities), which is defined as non-negative *m*-vector of activity level associated with constant return to scale production sectors in the economy,
- ***M*** (income level), defined as an *h*-vector of income levels, set as household within the model, and may include government entities.

Furthermore, those variables should satisfy three classes of conditions in order to be casted as an MCP Problem (Böhringer et al., 2003). They are:

- *Zero profit conditions or constant return to scale-producers:*

$$-\prod_j (p) = C_j(p) - R_j(p) \geq 0, \qquad \forall j$$

where (using Hotelling's Lemma):

$\prod_j (p)$: the unit profit function,

$C_j(p) \equiv \min\left\{\sum_i p_i \frac{\partial \Pi}{\partial p_i} \mid f_i(.) = 1\right\}$: the unit cost function, and

$R_j(p) \equiv \max\left\{\sum_i p_i \frac{\partial \Pi}{\partial p_i} \mid g_i(.) = 1\right\}$: the unit revenue function.

While the functions f_j and g_j represent the feasible input and output combinations of production in activity/sector *j*.

- *Market clearing conditions:*

$$\sum_j y_j \frac{\partial \prod_j (p)}{\partial p_i} + \sum_h b_{ih} \geq \sum_h d_{ih}, \quad \forall j$$

where:

b_{ih} : the initial endowment of household *h* with commodity *i*, and

$d_{ih}(p, M) \equiv \arg\max\{U_h(x) \mid p_i x_i M_h\}$: the demand for good *i* by household *h* maximising utility and U_h denotes the utility function of household *h*.

Due to linear homogeneity of profit functions and homogeneity of demand functions of degree zero in prices, the economic equilibrium only determines relative prices.

- *Income balance condition*

With b_{ih} as initial endowment of household *h* and *M* as income level (see above), the income balance condition is set:

$$\sum_h p_i b_{ih} = M_h \geq \sum_h p_i d_{ih} \,, \quad \forall j$$

For the utility function, households are restricted by their budget. That is, $\sum_h p_i b_{ih} = M_h = \sum_h p_i d_{ih}$, and Walras' law applies.

Utilising Walraw's law, aggregation of market clearance conditions and zero profit conditions produce:

$$\sum_j y_j \prod_j (p) = 0 \,; \qquad y_j \prod_j (p) = 0 \,, \ \forall j$$

and

$$p_i \left(\sum_j y_j \frac{\partial \prod_j (p)}{\partial p_i} + \sum_h b_{ih} - \sum_h d_{ih} \right) = p_{i\xi} \xi_i = 0 \,, \qquad \forall i$$

and

$$M_h \left(\sum_h p_i b_{ih} - \sum_h p_i d_{ih} \right) = 0 \,, \qquad \forall h$$

Accordingly, economic equilibrium exhibits complementarity between equilibrium variables and equilibrium conditions: positive market prices suggest market clearance. Excess commodity supplies imply prices fall to zero. Activities operate as long as they break even, in which negative revenues will close down the respective producing sectors.

The following MCP:

Given: $f : R^n \rightarrow R^n$

Find: $z \in R^n$

s.t. $f(z) \geq 0, z \geq 0, z^T f(z) = 0$

corresponds to the problem of finding an economic equilibrium for $z = [p, y, M]$ and $f(z) = \left[\Pi_j(p), \xi_i, \left(\sum_h p_i b_{ih} - \sum_h p_i d_{ih}\right)\right]$, thereby stating complementarity between variables and equilibrium conditions (Böhringer et al., 2003).

The MCP problem of the CGE model is written in GAMS, which stands for "Generalized Algebraic Modelling System", programming language (see www.gams.com). It is complimented by a sub system of mathematical programming system for general equilibrium (MPSGE) analysis, as shown in Rutherford (1999); and the programme is finally solved using the PATH solver.

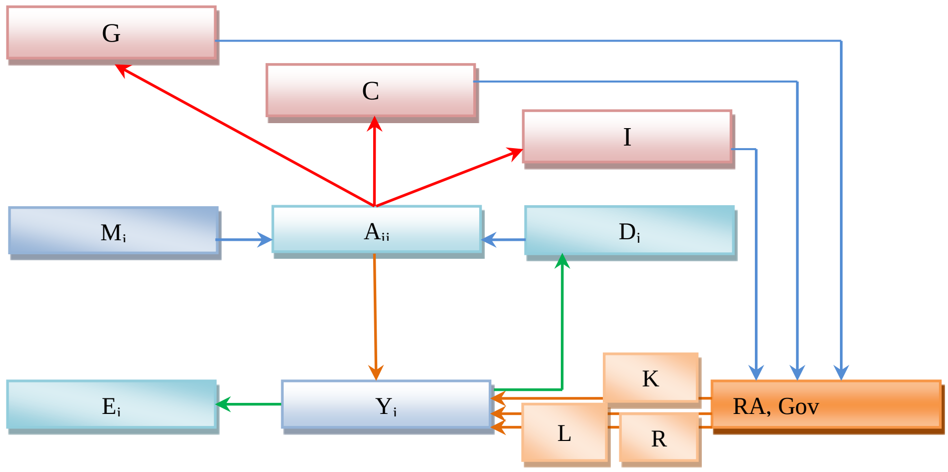
4.2. Economic flows in general equilibrium

This section deals with the development of a static CGE model within a context of the Berau District. Although the static model allows for its own simulations, following Thurlow (2008), the static model here is rather presented for serving as a basis for recursive dynamic model development. The static model herewith follows the specification of a standard CGE model of Lofgren et al. (2002). Meanwhile, Mathematical Programming System for General Equilibrium (MPSGE) representation of the standard CGE model is based on Rutherford[27]. The static model expresses production and distribution of commodities and services in an economy in a certain period of time, usually in a year.

The CGE model of the Berau District developed in this research is a single region type. That is, the Berau region trades only with the rest of world, which is defined from the Berau District's perspective i.e. including the rest of East Kalimantan, Indonesia, and outside Indonesia's border. The Berau District is assumed to be a small open economy and is unable to influence world's commodity price; hence it acts as a price taker. In general, the CGE model of the Berau District is assumed to follow the available general specification of Indonesia CGE model, for instance, production nesting and/or elasticity of substitution in production function.

[27]See http://www.mpsge.org/ifprimpsge/

The CGE model features inter-relationship between the varieties of economic agents such as producers and consumers through markets of commodities and factors of production. Within the static mode of the model, the relationship can be depicted as Figure 4.1.



Source: Rutherford and Light, 2001 (see http://www.mpsge.org/dnp2001.pdf)

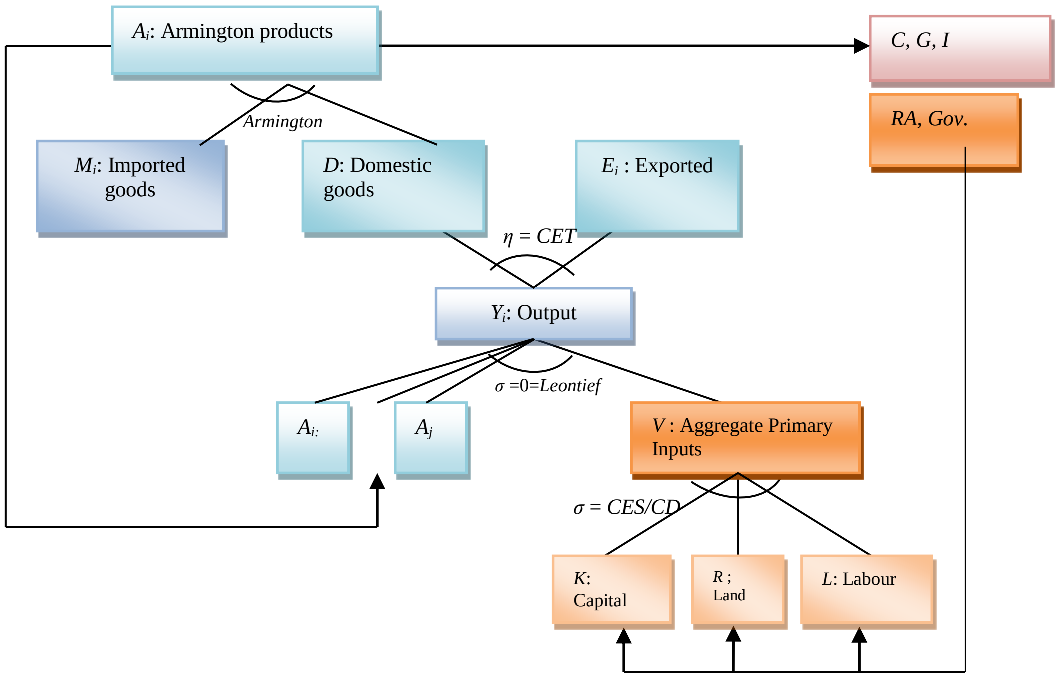
Figure 4.1 Economic flows in a static CGE model

In the figure, each sectoral activity (*i*) produces a certain level of output (Y_i) by converting capital (*K*), labour (*L*) and specific resources (R) (e.g. land), and intermediate inputs, which come from Armington aggregates (A_{ij}).The Armington aggregate (A_{ij}) is a composite of imported (M_j) and locally produced goods (D_j). The Armington composites are also used for final consumption i.e. Government consumption (*G*), Private Consumption (*C*), and Investment (*I*).

The output of a sector can be either marketed locally (D_i) or exported (E_i). Representative agents, *RAs*, depict a decision process of allocation of income to households and to government. The *RAs* own capital endowment (*K)*, labour endowment (*L)*, and resources(R), which are used for the production activities. The government (*Gov*) collects taxes, demands the Armington commodities and invests through saving activities.

4.3. Functional Forms

This section describes the structure of the functional forms used in the Berau District static CGE model, see shown by Figure 4.2. Terms σ and η denote the elasticity of substitution of production function and the elasticity of



transformation respectively.

Source: Rutherford and Light, 2001 (see http://www.mpsge.org/dnp2001.pdf)

Figure 4.2 General structure of the static model

Production function

In this model, every sector is assumed to act as a single representative producer whose production possibilities are characterised by multi-level production function. The production function follows a standard specification used in CGE models. Consider the Figure 4.2, a producing sector *Y* which produces output of commodities *i*. At the top level, to produce the commodities, each sector requires Armington aggregate intermediate inputs and aggregate primary inputs which are combined through a Leontief production function. The combination can be described in an algebraic form as:

$$Y_i = \min\left[\min\left(\frac{A_{ji}}{a_{jji}}\right), \frac{v_i}{b_i}\right]$$

At the second level, the primary inputs (value-added) of capital, labours and land are aggregated through a constant elasticity of substitution function (CES) specification, as follows. Note that this follows a specification available in the CGE models for Indonesia, see for example the works of Robinson et al. (1997), San et al. (2000) and Warr and Yusuf (2011)(Warr & Yusuf, 2011):

$$v_i = \theta(\alpha L_i^{\rho} + \beta K_i^{\rho} + (1-\alpha-\beta)N_i^{\rho})^{1/\rho}$$

where:

v_i	: value added,
θ	: factor productivity, and
$\alpha, \beta,$	: share of labour and capital used for production.

On the other side of the second level, intermediate inputs that comprise of exported and locally produced goods (Armington goods) which are aggregated in a fixed proportion.

Factors of production

Embedded into the production function are factors of production whose mobility is an important feature of a general equilibrium system. Mobility is defined as the capacity of factors of production to be reallocated across economic activities (producing sectors) in response to changes in rates of return. The greater the mobility that is chosen for factors of production, the greater is the economy’s capacity to respond to changes in the economy. Assumption of the degree of mobility should be consistent with the length of run that the problem/model is being analysed (Warr & Yusuf, 2011).

In the Berau District CGE model, all factors of production are assumed to be in a fixed supply. Labours is divided into agricultural and non-agricultural labour. Each category is further detailed into paid worker and non-paid worker types. Such classification is based on the Indonesian Labour Force Survey classification and the specification of labour in the Forestry Social Accounting Matrix of the Kutai Timur District (Pusat Rencana Kehutanan Departemen Kehutanan & Direktorat Neraca Konsumsi Badan Pusat Statistik, 2001). While the paid worker type is interpreted as the labour that receives a formal wage and salary, the non-paid worker does not receive a formal wage. During the construction of the Berau District Social Accounting Matrix dataset, the non-paid worker is paid 'an imputed wage', whose total value for every producing activity is excluded from 'the operating surplus' category in the input-output table (Warr & Yusuf, 2011; Yusuf, 2006). Also, the land factor of agricultural activity is further estimated using information on the net capital/land ratio of Kalimantan Island as depicted in the 2005 Indonesia Inter Regional Input Output Table[28]. Following Warr and Yusuf (2011), all labour categories are assumed to be less mobile across all sectors, while capital is assumed to be immobile. This reflects the short-medium run of the analysis.

Meanwhile, with regard to land factors specification in the Berau District CGE model, the specification of Warr & Yusuf (2011) was adopted. Land is assumed to non-homogenous and less-than perfectly mobile across sectors. For this purpose, an elasticity of land transformation of 0.5 is used. A transformation function representing how land is supplied into several agricultural activities is included in the model, as below.

$$N = h(N_{ag} N_{\log}) = \left(\delta^{N_{ag}} N_{ag}^{1+1/o} + (1-\delta^{N_{ag}}) N_{\log}^{1+1/o}\right)^{1/(1+1/o)}$$

[28] The 2005 Indonesia Inter Regional Input Output Table was provided by Mr. Daniel Pambudi (MONASH) and Budy Resosudarmo (ANU).

Where:

$\delta^{N_{ag}}$: benchmark value share of land used in agricultural sector out of total land used in all production (N),

$1-\delta^{N_{ag}}$: benchmark value share of land used in logging sector out of total land used in all production (N), and

o is the elasticity of transformation for land.

According to Warr and Yusuf (2011), despite its uncertainty, elasticity of transformation between land use between forestry and crop production is 0.5. Furthermore, within the land use for the crop production, the elasticity of transformation of land use between the crops is 0.75. In the Berau CGE model, it is simplified that the elasticity of land transformation in all agricultural activities is assumed 0.5, close to the parameter used in Warr and Yusuf (2011)).

Production output

Every sector's output Y_i can be marketed locally as final and intermediate consumption (as domestic goods D_i) and exported (E_i). The commodities are assumed to be imperfect substitutes and have a constant of elasticity of transformation η. An algebraic formulation of this transformation function is as follow:

$$Y_i = g(D_i E_i) = \left(\delta_i^D D_i^{1+1/\eta} + (1-\delta_i^D) E_i^{1+1/\eta}\right)^{1/(1+1/\eta)}$$

Where δ_i D is the benchmark value share of output marketed domestically out of the total production for sector i and η represents to the elasticity of transformation.

The Berau District CGE Model has twenty three activities producing twenty three commodities. That is, there is one-to-one mapping between activities and commodities. The distribution of the sectors/activities and commodities can be seen in Table 6.6 of Chapter 6 and Appendix 6.2.

Imports

The model includes an Armington representation of import demand. The Armington commodities A_i, are composite of domestic outputs and imports. The domestic and imported components of the same commodities are assumed to be imperfect substitutes and the choice between utilising these goods is assumed to be governed by a constant elasticity of substitution (CES) or the Armington elasticity. This is represented by an algebraic equation:

$$A_{ji} = (\delta_i^D D_i^{1-1/\sigma} + (1-\delta_i^D)M_i^{1-1/\sigma})^{\frac{1}{1-1/\sigma}}$$

The Armington products are used for both final consumption that is, for private consumption, government consumption, and investment as well as for intermediate inputs in the production activities.

Final Consumption of Households, Government and Investor

Representative agents of household and government own endowment factors of primary inputs such as capital (*K*), labours (*L*), and (*R*) lands. The representative agents also demand investment (through saving) and consumptions (private and public goods for households and government respectively). In the regional CGE model, these institutions may both receive and transfer funds from rest of world's institutions, as well as exchange funds between the same institutions (*trn*).

All domestic demands (private and government consumption and investment demand and intermediate demand) require Armington products of imported and locally commodities. The domestic demand is determined by the assumption that the domestic consumers minimise cost subject to imperfect substitutability, captured by an Armington CES aggregation function.

Consumption by households is represented by a Cobb-Douglas utility function. That is, the demand function is derived from utility function subject to budget constraint:

$$U_{ra}(c_i) = \prod_i c_i^{\alpha}, \quad \sum_i \alpha_i = 1$$

Where c_i represent commodity i and α_i is share of commodity i The utility maximisation is subject to a budget constraint:

$$\max U_{ra}(c_i)$$

Subject to:

$$\sum_i p_i c_i \leq p_K K + p_L L + p_R R + nettrn - I_{ra}$$

where:

$$U_{ra}(c_i) = \prod_i c_i^{\alpha}$$

p_i, p_K, p_L, p_R	: prices of commodity *i*, capital, labour, and land,
nettrn	: net transfers between households and other institutions
I_{ra}	: saving/investment of households.

Following the household specification of *Pusat Rencana Kehutanan Departemen Kehutanan* or Centre for Forestry Planning, the Indonesian Ministry of Forestry (2001), the Berau District CGE model features a simplified households grouping consisting of forestry households, other-agricultural households, and non-agricultural households, and other households type. Each group except the other household type is further divided into two types i.e. worker and self-employee household types. For example, the forestry household worker implies either head of the household's occupation is as worker at the forestry sector or the household's main income is derived from working at the sector. Thus, other types of households are interpreted in a similar fashion. Finally, the other household type is not detailed further.

Government

The government earns revenues from household and enterprise direct taxes, indirect taxes i.e. sales tax for the Armington commodities, capital rents and transfers from Rest of World (e.g. for the Berau District, it receives transfers from central government as well as transfers to RoW). The government uses revenues to purchase goods and services for consumption and investment. It is assumed that the government demands a fixed proportion of commodities[29]:

$$U_{gov}(c_i) = \min\left(\frac{c_i}{a_i}\right)$$

where c_i is commodity I and a_i is share of c_i out of total consumed commodity, subject to government budget:

$$\sum_i p_i c_i \leq taxes + nettrn - I_{gov}$$

Where $\sum_i p_i c$ is the government's consumption, *taxes* government revenue from taxes, *nettrn* denotes for (net) transfers, and I_{gov} denotes for government savings.

Investment Demand

Regional investment equals to regional saving and is financed by aggregate regional savings. The regional savings is derived from households saving, enterprise saving, government savings and foreign saving. The saving is used to purchase goods and services by maximise the investment demand through a fixed proportion aggregation of goods and services.

Macroeconomic closure

In addition to factors and commodity market clearings, there are three types of macroeconomic closure or constraints in the standard CGE model. They are foreign exchange balance, government balance and saving investment balance constraints (Lofgren et al., 2002).

In the Berau CGE model, the district is assumed to be a small open economy where imports and exports prices ($\overline{p}_i^E, \overline{p}_i^M$) are determined exogenously. The Berau CGE is a single region CGE model and has the same currency with the rest of the world (ROW). For this model, the initial exchange rate is set as unity (Burfisher, 2011). The exchange rate actually determines a real exchange rate,

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[29] Modified from An Emipirical Model. Markusen, J., Rutherford, T., & Light, M. (2004) in MPSGE: A user's Guide. 2004. . Markusen, J., and Rutherford, T. (2004). University of Colorado.

which is the relative price of traded to non-traded goods. Note that the traded goods are products that are exported and imported; while the non-traded goods are commodities that are produced and sold in the domestic markets (Burfisher, 2011).

For the government balance condition, the model assumes that the (local) government uses the fixed direct tax rate (for all period) and the government saving is a residual after their earning is used for consumption. It is assumed that the government consumption is fixed (later in a dynamic model, the government consumption is assumed to grow at a fix rate). The government in the SAM Table is assumed to be only the local government of the Berau District; relationship with central government implicitly occurs within transfers with the rest of the world (ROW).

Finally, for the investment-saving closure, the regional investment adjusts to the level of regional savings (savings driven), where the regional savings is financed by private savings, government savings and foreign savings. In addition, these specifications follow those of existing CGE models for Indonesia such as in Dee (1991) and Warr and Yusuf (2011).

4.4. Dynamic Specification

The impact of policy changes may occur over time and include effects of changes in investment and the rate of capital accumulation. The dynamic recursive model formulation is able to capture the detailed relationship between policy-changes, factor accumulation, and productivity changes (Thurlow, 2008). The recursive model solves a series of new equilibriums each period based on the solved equilibrium of the previous period.

Over the time period being investigated several policy-independent changes are assumed to take place. Together these effects form a projected or counterfactual growth path of the economy. These inter-period adjustments include labour and population growth, capital accumulation, factor productivity changes, and changes in government expenditure (Thurlow, 2008). The MPSGE syntax of the dynamisation follows Rutherford[30].

Labour growth

The labour is assumed to grow at an exogenous rate of *gr* and set as the following equation:

$$L_t = L_0(1+gr),$$

Which also equals to (for the current period *t*),

$$L_t = L_{(t-1)}(1+gr),$$

where L_t represents labour at time t, L_0 denotes initial labour force, and *gr* is an exogenous labour growth. The above equation was re-written in MPSGE syntax as a labour index multiplier (Lb), which is inserted within the households' block of the MPSGE code, as follow:

$$Lb = Lb*(1+gr).$$

In the recursive CGE model, a constant growth rate (*gr*) of effective labour supply is the driving force of the economic growth. The growth of effective labour supply is a vector of demographic development (that is increases in the number of workers) and increased labour productivity (that is increases in production per worker) (Dellink, 2010). Unfortunately, records of effective unit of labour growth of the Berau District are not available. Hence, the labour growth rate of the Berau District is set to be similar to the real gross regional product growth rate of the Berau District.

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[30]http://www.mpsge.org/recurs

Capital Growth

A change in total capital supply is assumed endogenous in the recursive dynamic model. In a particular period the total available capital is determined by the previous year's capital stock and the current level of investment. For the base year (initial) capital stock, total available capital is divided by the sum of depreciation level and interest rate.

In this model, the equation of motion for capital growth is simply defined as follows:

$$K_t = K_{t-1}(1-\delta) + I_t \,,$$

where:

K_t : capital level at the current year *t*,
K_{t-1} : previous period capital,
δ : rate of depreciation,
I_t : investment level at the current year.

Capital stock equals total capital demanded by sector activities *kd0* divided by the sum of exogenous interest rate (ir) and depreciation rate (δ). In the model, the equation is slightly modified to form a capital index multiplier to the capital endowment of the private institutions.

Data on the Berau District's depreciation rate is not available, so data from Indonesia as a whole was used. According to Schundlen (2013), the capital depreciation rate of manufacturing sectors for Indonesia is estimated between 8% and 14%. Meanwhile, Bu (2011) also studies that the rate in Indonesia's capital depreciation, observed in manufacturing industries, has been between 4% and 16%, for the period 1951-1990. In addition, BKPM (*Badan Koordinasi Penanaman Modal Indonesia* or Investment Coordination Board) recommends that a 5% depreciation rate be used for non-building and permanent building assets with 20 year life[31]. For this simulation, the depreciation rate of 5% was used, as it was also suggested by a National Statistics officer[32].

Real interest (discount) rate

Data from International Monetary Fund indicate that Indonesia real interest rate has been above 10% for the period 1995 to 2005. From 2005 to 2010, the rate has decline to 6.5%, see Figure 4.3). In this simulation, the real interest used is 10% which also reflect high risk of investing in a developing country.

Source: Data from International Monetary Fund

Figure 4.3 Real Interest rate in Indonesia, 2005 – 2010.

4.5. Conclusion

The chapter has presented the method of computable general equilibrium (CGE) modelling utilised in this research. A static CGE model of the Berau District has been developed to provide a basis for a recursive dynamic CGE model. Within a static framework, economic flows, assumed functional forms that describe behaviour of producers, and consumers were described. Dynamic specifications which required to move the static CGE into a recursive dynamic CGE version were also explained. In addition, it is worth to mention that the CGE model

[31] http://www.bkpm.go.id/mobile/content/p14.php?l=1&m=14&i=88 visited 2012.
[32] Mr. Wisnu Winardi, personal communication

development benefits from mathematical programming system for general equilibrium (MPSGE), a subsystem designed for general equilibrium problem by Rutherford (1999), under the Generalized Algebra Modelling system.

Chapter 5 Methodology for Constructing Input-Output and Social Accounting Matrix Tables

This chapter presents approaches used to construct input-output and social accounting matrix tables for the Berau District, which will serve as the database for CGE modelling. In general, the input-output and social accounting matrix tables have been reviewed in Chapter 3. In this chapter, the input-output and social accounting tables will be elucidated as the methods to construct them are explained.

5.1 Preparing Dataset for CGE Modelling

A computable general equilibrium requires an input-output table and a social accounting matrix table as its database. Hence, this section will deal with the construction of an input-output and a social accounting matrix tables for a region. As it is indicated in Chapter 3, a method developed by Kronenberg (2007, 2009a, 2009b) was utilised to construct the Berau District input-output table. Subsequently, information from the input-output table was transferred into the relevant sub matrices of a social accounting matrix framework. To complete the social accounting matrix table, other sub matrices were filled using available information e.g. from surveys, financial records; or even estimated by government statistical officers familiar with the data. In short, a process of constructing the Berau District SAM table can be described as below:

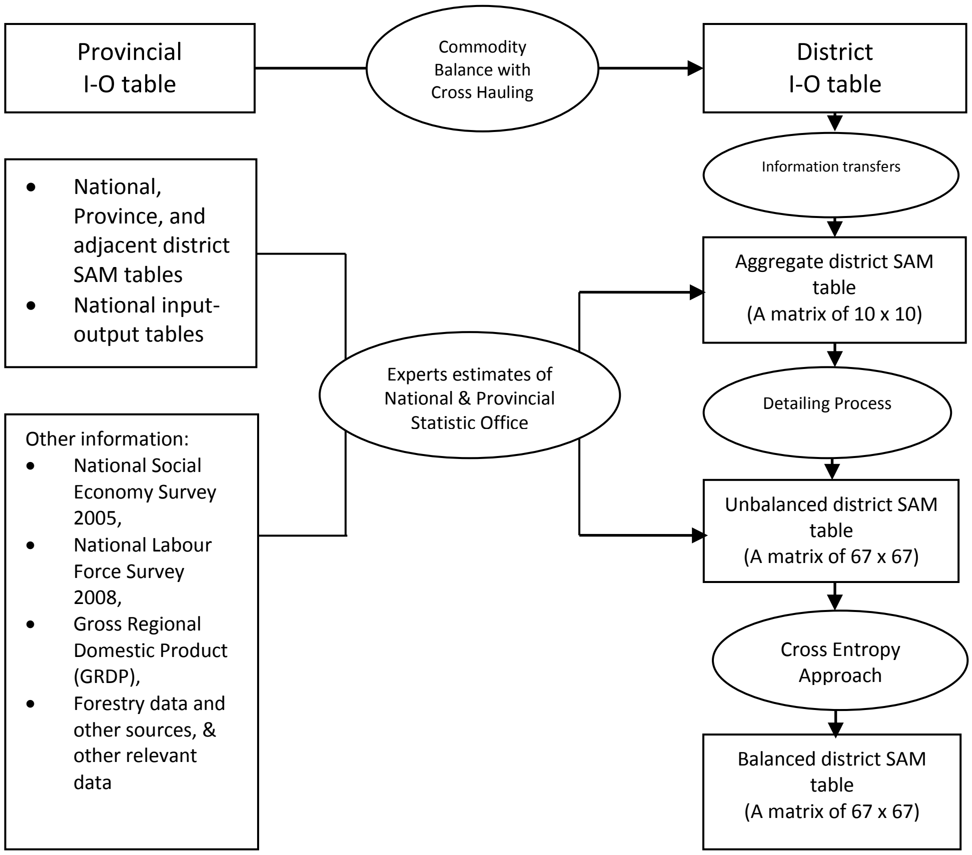


Figure 5.1 Procedure to construct the Berau District SAM table

5.1.1 Structure of an input-output table

Input-output tables depict the interrelationship among various producers and consumers within an economy. A typical input-output table is presented in the Table 5.1. The input-output table consists of four blocks, which are usually referred as quadrants. Most input-output tables, however, contain only three quadrants, as follows (Badan Pusat Statistik, 2008b; Badan Pusat Statistik & BAPPEDA Kalimantan Timur, 2008):

Table 5.1 A Typical Input-Output Table with Two Sectors

Output Allocation / Input Structure	Intermediate Demand		Total Intermediate Demand	Domestic Final Demand	Exports	Total Final Demand	**Total Demand**	Supply		**Total Supply**
	Sector 1	Sector 2						Domestic Output	Imports	
Intermediate Input										
Sector 1	$z_{1,1}$	$z_{1,2}$	z_1^D	d_1	e_1	f_1	u_1	x_1	m_1	s_1
Sector 2	$z_{2,1}$	$z_{2,2}$	z_2^D	d_2	e_2	f_2	u_2	x_2	m_2	s_2
Total Intermediate Input	z_1^U	z_2^U								
Value added (Primary Inputs)	w_1	w_2								
Total Input/Output	x_1	x_2								

Source:

Department for Economic and Social Affairs Statistic Division (1999). It was modified to suit a typical Indonesian input-output table. Meanwhile, the symbol was adapted from Kronenberg (2009).

a. The first quadrant (intermediate demand matrix)

This quadrant shows an interrelationship among economic activities or sectors within a region i.e. referred as an inter-industry matrix *Z*. Elements of the inter-industry matrix are denoted by $z_{i,j}$, where *i* refers to commodities produced by sector *j*. Within a row *i*, the element of *z* show how many units of commodity *i* are allocated as intermediate inputs by each sector. The row total represents total intermediate demand, and is defined as a vector of z^D:

$$z^D \equiv (z_1^D, ..., z_n^D) \tag{1.}$$

$$\text{where, } z^D \equiv \sum_{j=1}^{n} z_{i,j}$$

Within a column *j* of *Z*, there are inputs to produce commodity *i*. Hence, the total column of *Z* represents the total intermediate inputs utilised by the producing sectors. A vector of z^U is defined as:

$$z^U \equiv (z_1^U, ..., z_n^U) \tag{2.}$$

$$\text{where, } z^U \equiv \sum_{j=1}^{n} z_{i,j}$$

b. The second quadrant (final demand)

This quadrant shows a relationship between economic activities (an intermediate matrix of *Z*) and final demand or final user of goods and services. The final demand of goods and services comprises domestic final demand *d* (in the form of households and government consumption, capital accumulation, and changes in stock) and export *e*. Because the total demands *u* equals the intermediate demand *z* and the final demand *f*, then:

$$u \equiv (z^D + f) \tag{3.}$$

hence,

$$u \equiv (z^D + d + e) \tag{4.}$$

c. The third quadrant (production factors)

This quadrant, which is located at the bottom of an input-output table, is also referred to as value-added or primary factors. This represents a partial contribution of factors of production in the production process.The primary factors may consist of salaries and wages, operating surplus, depreciation, net indirect tax, and subsidies. The operating surplus may include net profit, land rent, direct tax, bank rent, and grant.

The primary inputs are denoted by ***w*.** Summing the primary inputs *w* to the intermediate inputs z^U results in the domestic output ***x*,** and is denoted as the following:

$$x \equiv (z^U + w) \tag{5.}$$

Within an input-output system, total demand should equals total supply. Since the total supply consists of domestic products and imports, then

$$s \equiv (x + m) \tag{6.}$$

And finally, the total demand equals the total supply:

$$s = u \tag{7.}$$

d. The fourth quadrant (production factors and institutions)

An additional quadrant, the fourth quadrant, explains the relationship between production factors and final demands. It contains information regarding the amount of income distributed to households and government as well as being transferred abroad and invested. It is not common that an input-output table includes this quadrant. When it is included, the input-output table is extended to become a social accounting matrix table.

5.1.2 Constructing a Distric-level Input-Output Table using the Commodity Balance Approach with Cross-Hauling

Kronenberg proposed a new approach to construct an input-output table using a non-survey technique called Commodity Balance Approach with Cross-Hauling (see Chapter 3). Several reasons have been identified regarding the appropriateness of the Commodity Balance Approach with Cross-Hauling to construct a regional input-output table. These are:

(1) The method applies on a symmetric input-output table (Kronenberg 2009), as presented in Table 5.1[33]. The Indonesian Input-Output Table (including the East Kalimantan Province Input-Output Table) is developed in accordance with the symmetric input-output framework (Department for Economic and Social Affairs Statistic Division, 1999), hence the method can be applied to the East Kalimantan Input-Output Table.

[33] Input-output framework comprises three types of table: supply and use table, a table linking supply and use table, and symetric input-output table. Supply and use tables consist of industry by product matrix. Supply table reveals the supply side i.e. domestic and rest of world's supply, and the use table depicts the use side that is, for intermediate and final use (including domestic use, capital accumulation and export). This retains the industry by product matrix composition.

While the combination of supply table simply aggregate supply and use tables and it still consists of a matrix by industry by products, the symetric input-output combine and integrate the supply and use table into an industry by indutry matrix.

(2) Kronenberg (2007, 2009) claims that his method offers advantages of being more satisfied from a theoretical point of view and less mechanistic in nature. These probably represent answers to Round's (1983, p. 209) critic that 'many non-survey methods are sadly lacking in theoretical and empirical underpinnings…'.

(3) The method improves the traditional commodity balance approach by taking into account of the reality of cross-hauling (see section 3.5.3 of Chapter 3) which is usually ignored in the traditional approaches to generate regional input-output table.

(4) Jackson (1998) suggests that, for providing a basis to develop a social accounting matrix table or computable general equilibrium model, a regionalisation approach which is based on the commodity balance method should be used. The approach developed by Kronenberg is expected to meet this requirement since it is naturally based on the commodity balance approach.

Isard (1953) firstly introduces the commodity balance approach to the 'regionalisation' process[34]. The term commodity balance or net export implies the different between exports and imports, and is defined by:

$$b = e - m \quad (8.)$$

By solving *e* for equation (4); that is, $e = u - (z^D + d)$, and solving *m* for equation (6); that is, $m = s - x$; and considering that *u* = *s;* then inserting *e* and *m* into equation (8), the regional commodity balance can be estimated (Kronenberg, 2009), as follows:

$$b = e - m \quad (9.)$$

$$b = u - (z^D + d) - (s - x) \quad (10.)$$

$$b^{di} = x^{di} - (z^{Ddi} + d^{di}) \quad (11.)$$

where x denotes domestic output , z^D denotes intermediate demand, d symbolises final demand excluding export, and the superscript di denotes the district level.

[34] The superscripts *di* and *pr* denote the district and provincial levels, respectively

Thus, equation (11) implies that estimating a regional commodity balance requires an estimation of regional output and total regional demand/use (a sum of intermediate demand and final demand excluding export).

In order to construct a regional input-output table, the Commodity Balance approach with Cross Hauling involves several steps as follows (Kronenberg, 2007, 2009):

a. Estimating Regional Output including Intermediate Demand

Intermediate inputs and primary inputs form a regional output. To estimate the regional output from national output, most input-output modellers use share of employment between regional to national levels to scale down the national output[35]. This requires an assumption that labour production in the region is similar to its national average (Jackson, 1998; Kronenberg, 2009; Lahr, 2001).

Furthermore, Lahr (2001) suggests using more superior data e.g. information on primary inputs/value added such as labour income or expenditure. Therefore, superior information such as sectoral domestic products were used to estimate the Berau District's output. Such superior information can be obtained from the District, Province and National Statistic Office. This is defined by:

$$x_i^{di} = \frac{DP_i^{di}}{DP_i^{pr}} . x_i^{pr} \tag{12.}$$

where x_i^{di} represents the District's output of commodity *i*, x_i^{pr} represents the Province's production of commodity *i*, and DP_i stands for domestic product of sector *i*.

[35] Based on an initial attempt to estimate the Berau District's production (output) from East Kalimantan Province I-O Table, it was likely that utilising share of employment resulted in close estimates for sectors that were labour intensive (e.g. agriculture sector). For sectors that are capital intensive like coal mining, however, the calculated domestic production tends to be overestimated.

Within an input-output system, a technical coefficient[36] $a_{i,j}$, is defined as the amount of input *i* that a sector uses to produce one unit of output x_j . From the above input-output table, the technical coefficient is denoted as:

$$a_{i,j} = \frac{z_{i,j}}{x_j} \quad \sim \qquad (13.)$$

$$z_{i,j} = a_j^i . x_j$$

It is worth noting that the inter-industry matrix *Z* contains both domestic and imported goods.

b. Estimating Primary Inputs/ Added Value

To produce regional outputs, the sectors require intermediate inputs and primary inputs/value added. Structure of regional primary inputs/value added is usually assumed to follow that of their national counterparts. The regional primary input is traditionally estimated using share of employment data, but more superior data are preferred if they are available. In this case, share of domestic products between Berau District and East Kalimantan Province was employed[37], as follows:

$$w_i^{di} = \frac{DP_i^{di}}{DP_i^{pr}} . w_i^{pr} \qquad (14.)$$

where w_i^{di} represents the estimated district level primary inputs/value added, w_i^{pr} is the Province's primary input/value-added, and DP_i^{di} and DP_i^{pr} denote the domestic product of sector *i* of the district level and the province level, respectively.

[36] Sometimes it is referred as technology.

[37] This was suggested by a national statistic officer.

c. Estimating Final Demand excluding Export

Adopting the structure of national final demand to be used for estimating regional one employs an assumption that regional final demand structure follows national counterparts (Jackson, 1998; Kronenberg, 2009). Jackson (1998) suggests that the final demand may also be a function of expenditure or domestic production, although he does not further elucidate his proposition[38].

In a commodity-balance approach, typically share of total employment is utilised to scale down the column of national final demand (Kronenberg, 2009). However, if data on the total regional final demand excluding export at regional and national levels are available, they should be used instead (Jackson, 1998). Therefore, the Berau District Final Demand excluding Exports would be estimated by:

$$d_i^{di} = \frac{Fd^{di}}{Fd^{pr}} . d_i^{pr} \tag{15.}$$

where Fd indicates the total final demand excluding export, d_i^{di} refers to estimated district final demand excluding export of commodity *i* of sector *j*, d_i^{pr} denotes the province final demand of commodity *i* of sector *j*.

The district final demand excluding export *d* consists of households and government consumption, capital accumulation and changes in stock.

d. Estimating cross-hauling

Kronenberg (2009) further elucidates the role of cross hauling, which was previously defined as simultaneous export and import of the same commodity, and the approach to estimate regional trade patterns which involves the cross hauling.

[38] The national statistic officer agreed to the opinion that the district's structure of finald demand was most likely similar to that of the province since there was not any significant investments in the Berau District within the last few years.

The cross-hauling is defined as:

$$q_i = (e_i + m_i) - |e_i - m_i| \qquad (16.)$$

where q_i denotes cross-hauling, (e_i + m_i) represents trade volume, and $|e_i - m_i|$ represents the trade balance or net export (it is referred as absolute value, since the calculation of trade balance may result in a negative value).

This equation implies that export, import, and the trade, by definition, cannot be negative. On the other hand, the trade balance can be negative. The equation also states that the cross-hauling will be zero if export or import (or both) equals to zero. The traditional non-survey methods fail to acknowledge cross hauling, since they assume that the sector is export or import oriented and set either *e* or *m* to zero; therefore, resulting into an assumption that the cross-hauling is zero (Kronenberg, 2009).

e. Estimating Product Heterogeneity

According to Kronenberg (2009) cross-hauling is a function of product heterogeneity. Therefore, if cross hauling is observed, the degree of product heterogeneity can be calculated. However, the cross hauling also depends on the fact that a region consumes or produces a certain commodity. If a region does not consume a certain commodity then it has no reason to import the commodity. On the other hand, if the region does not produce a certain commodity, it has no reason to engage in cross hauling of that product because the region will simply import to fulfil its demand for the product. For these reasons, the cross hauling is assumed as a function of product heterogeneity, domestic production, domestic final and intermediate use (Kronenberg, 2009):

$$q_i = q_i(x, z_i^D, d_i, h_i) \qquad (17.)$$

In the equation, qi represents cross-hauling and the degree of product heterogeneity is denoted by *hi*. The measure of *hi* is defined in such a way that if the product is perfectly homogeneous, *hi* is zero, and if the product is perfectly heterogeneous, it approaches positive infinity. This approach is based on an estimation of *hi* of the above equation (Kronenberg, 2009).

In equation (18), the total volume is a sum of export and import, and is denoted by:

$$v_i = e_i + m_i \tag{18.}$$

The equation (16) previously states that trade balance is the difference between export e_i and import m_i. Then, using equation (18), export and import are written as a function of trade volume and trade balance:

$$m_i = \frac{v_i - b_i}{2} \tag{19.}$$

$$m_i = \frac{v_i + b_i}{2} \tag{20.}$$

Regarding the equations (16) and (18), the trade volume can also be rewritten as a sum of the absolute value of trade balance bi and the amount of cross hauling qi as:

$$q_i = (e_i + m_i) - |e_i - m_i| \quad \text{and}$$

$$v_i = e_i + m_i$$

$$\text{therefore} \quad q_i = v_i - |b_i| \quad \text{then,}$$

$$v_i = |b_i| + q_i \tag{21.}$$

Kronenberg (2009) further demonstrates that the equation follows the definition of the cross- hauling and the trade volume as in equation (16) and trade balance in equation (9). It is shown in equation (21) that if the cross-hauling does not occur, the equation (21) can be fulfilled if either exports or imports (or both) are zero i.e. this approach becomes similar to the original commodity balance approach.

In addition, Kronenberg (2009, p. 50-51) states that the function of equation (17) can be to some extent arbitrary; but he argues that whatever specific function selected it should fulfil a number of requirements:

a) A cross hauling occurs because of product heterogeneity. If there is no product heterogeneity, then there should be no cross hauling. Therefore, the specific form should fulfil condition that $h_i = 0$ implies $q_i = 0$.
b) A simultaneous rise in production and consumption, which sums to a simple scaling up of the economy, should also cause a proportional increase in q_i.
c) If the production of *i* increase by a certain amount while consumption remains constant, exports of good *i* will increase to some extent. As most sectors demand some intra-sectoral inputs in their production, and some of those inputs delivered from outside the region, import of good *i* is expected to increase. Increase of export and import will increase the amount of q_i. For this reason, an increase in production should cause a less than proportional increase in q_i.
d) For the consumption, a similar argument can be constructed. Hence, an increase in consumption should cause a less than proportional increase in q_i.

Kronenberg (2009) simplifies the function as:

$$q_i = h_i(x_i + z_i + d_i) \tag{22.}$$

In which, cross hauling is a proportional to the sum of domestic production x_i and total demand $z_i + d_i$, and the factor of product heterogeneity h_i . This equation is claimed to comply the afforementioned requirements (Kronenberg, 2009).

Equation (22) is then substituted into equation (21), and h_i is solved, as the following:

$$\begin{aligned} v_i &= |b_i| + h_i(x_i + z_i + d_i) \\ h_i &= \frac{v_i - |b_i|}{(x_i + z_i + d_i)} \end{aligned} \tag{23.}$$

Finally, the degree of heterogeneity h_i (of a certain commodity) can be estimated using information from the parent input-output table. Product heterogeneity is specific to a commodity, and it is not characterised by geographical location. Therefore, a commodity of certain region is assumed to have similar product heterogeneity of a different region (Kronenberg, 2009). Therefore, it is assumed that $h_i^{di} = h_i^{pr}$.

f. Estimating District Trade Patterns

District trade pattern, defined as the amount of exports and imports, are estimated following the estimation of the district's production (domestic product) x_i^{di}, intermediate demand z_i^{di}, and final demand excluding exports d_i^{di}.The district's production, intermediate demand, final demand excluding export can be estimated using equations (12), (14), and (15), respectively. Then, the district trade balance of each sector b_i^{di} is calculated using equation (11).

District cross-hauling of sector *i*, q_i^{di}, is estimated using equation (22), by utilising information of domestic output, intermediate demand and final demand excluding export of x_i^{di}, z_i^{di}, and d_i^{di}, respectively. The equation requires information of h_i, which can be estimated from the parent input-output table, by using equation (23).

The estimated district trade balance b_i^{di} and cross-hauling q_i^{di} are then substituted into equation (21) to obtain the trade volume of commodity *i* v_i. Finally, the district imports and exports, are then estimated using equation (19) and (20) respectively, by employing the v_i and the trade balance commodity *i* b_i^{di}.

It is important to note that in a regionalised input-output table, most modellers do not differentiate between international trades or intra-national trade (trade between regions or districts in a nation)[39] and is unfortunate that methods to distinguish these trades are not available. The approach proposed by Kronenberg (2009) does not distinguish between international trade and intra-national trade. Jackson (1998) attempts to propose approach to separate between, what he calls, rest-of-world imports (or exports) and rest-of-nation imports (or exports). In this study, however, the import is not differentiated because of lack of information e.g. records of export to overseas.

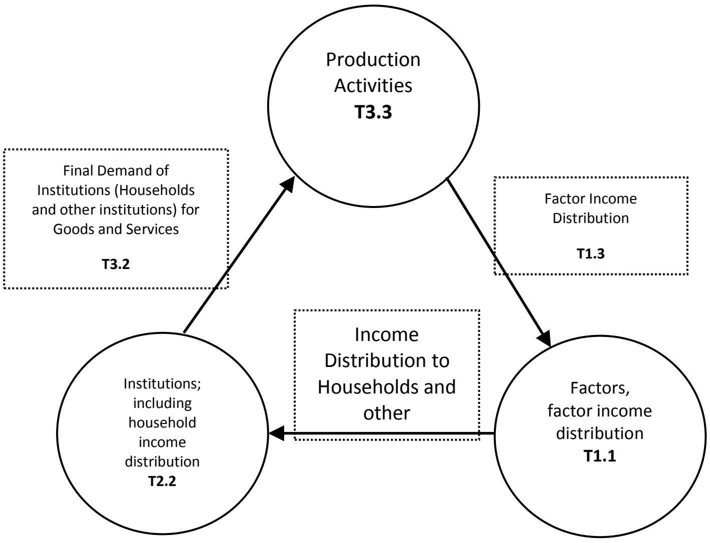
After all information have been calculated, the intermediate transactions Z^{di}, the estimated primary input w^{di}, the regional output x^{di}, the final demand excluding export d^{di} and the regional trades (exports e^{di} and imports m^{di}) are finally assembled to produce a prediction of district input-output table.

5.1.3 Structure of the Social Accounting Matrix Table

Section 3.5.1 of Chapter 3 provides overview of a social accounting matrix. In this section, the social accounting matrix is further elucidated to provide a description of constructing it as data framework for CGE analysis. Being an extension of an input-output table, the social accounting matrix depicts inter-relationships between three major accounts such as production activities, institutions (including households' income distribution) and factors (factor incomes distribution). These three accounts are grouped as endogenous[40] accounts of the social accounting matrix table (Thorbecke & Babcock, 2000). This inter-relationship is shown in Figure 5.2.

[39] The 2007 East Kalimantan Input-Output Table and other official province and district input-output tables in Indonesia do not differentiate between international and intra-national exports (imports).

[40] Endogenous accounts are accounts whose values are determined by the states of other variables in the system. In contrast, exogenous accounts are independent from the states of other variables (see http://www-personal.umd.umich.edu/~delittle/Encyclopedia%20entries/Endogenous%20variable.htm).



Source: Thorbecke & Babcock (2000)

Note that T symbolises a relevant sub matrix in the simplified SAM table of Table 5.2. Hence, for example T1.3 indicates the intersection of row 1 i.e. factors, and column 3 i.e. production activities.

Figure 5.2 Simplified Inter-relationships among principal SAM accounts

Figure 5.2 reveals the economic flows and inter-relations captured by a SAM. The producing activities generate value-added, which is used to make payments for factors of production/primary inputs (e.g. labours, capital and land). The primary inputs consist of profits, salary and wages and payments to government. These income flows into households or government through a redistribution process. By institutions, the incomes are spent for final consumption (for goods and services) or are saved. Finally, payment for goods and services by institutions are made to the producing activities, and the whole process continues.

Table 5.2 shows a simplified social accounting matrix table which shows the above accounts. The social accounting matrix table also shows a group of exogenous accounts, which consists of capital account, net indirect account, and rest of world.

Although the steps required to construct the district social accounting matrix table have been already presented in section 3.5.1 of Chapter 3, a summary is provided here with reference to Figure 5.1. In addition, to estimate the district social accounting matrix table, an aggregate SAM matrix table will be created to serve as a basis for the expanded version of the district SAM table.

Table 5.2 A Simplified Social Accounting Matrix Table

				Expenditures					
				Factors of Production	Institutions (Household, Government and Enterprise	Production Activities	Combined Capital	Rest of World	Total
				Endogenous Accounts			Exogenous Accounts		
				1	2	3	4	5	
Receipts	Factors of Production	Endogenous Accounts	1			Factorial Income Distribution (T1.3)		Factor Income Transfer from Rest of World	Income of Factors
	Institutions (Household, Government and Enterprise		2	Income Distribution to Households and other institutions (T2.1)	Transfers, Taxes and Subsidies (T2.2)			Receipts of Institutions from Rest of World	Income of Institutions
	Producing Sector		3		Final Demand of Institutions (Households and other institutions) for Goods and Services (T3.2)	Intermediate Demand T3.3)	Gross Capital Formation	Exports	Gross Demand = Gross Output
	Combined Capital	Exogenous Accounts	4		Domestic Saving			Balance of Payments Current Account Deficit	Aggregate Savings
	Rest of World		5	Allocation of Factor of Production's Income to Rest of World	Institutions' Tranfers to Rest of World	Imports		Transfer and other accounts	Total Foreign Exchande Outflow
	Total			Outlay (=Income) of Factors	Expenditure of Institutions	Gross Output	Aggregate Investment	Total Foreign Exchange Inflow	

Source: Thorbecke & Babcock (2000, p.17)

Note: information of the highlighted blocks is from an input-output table.

Consequently, at the first stage, using the aggregate SAM matrix form, steps will be carried out are:

A. *Transferring the aggregate information from the constructed input-output table*

Aggregate information transferred includes sum of intermediate (domestic and imported) input matrix, sum of make/use matrix, labour payment by industries, sum of final demand (domestic and imported), sum of tariff on imported commodities (if any), and ROW's receipts i.e. sum of exports and import values.

B. Filling other information

In this step, the rest of the matrix accounts will be filled using relevant information. For example, the sub matrix of T2.1 of Table 5.2 was estimated using information obtained from national a social economic survey[41], while other information e.g. transfers were taken from e.g. central government bank reports (Bank of Indonesia). In other cases, the sub-matrices were left as balancing items (Hosoe, Gasawa, & Hashimoto, 2010)or even experts' opinion are employed (Leeuwen & Nijkamp, 2009).

At the second stage, the aggregate SAM matrix which has been completed will be expanded. This involves:

C. Detailing process

In this step, sectors, factor payments and households' expenditure and incomes are disaggregated in accordance to the specific purpose of the study. It is designed that social accounting matrix table has less sectoral disaggregation than that of an input-output table because existing data do not support a high level of sectoral disaggregation. However, important sectors that are relevant to the study objective will be retained. Households will also be categorised according to the study objective and they are detailed into forestry households, agriculture (excluding forestry households), and other-type households. Each household group will be broken down into two types of household i.e. paid-worker households and self-employee households. Meanwhile, labour was disaggregated into paid and non-paid labour types. It is worth noting that in Indonesia Statistical term, labour category refers to type main income that the labour obtains (e.g. as a paid worker or self-employee), while the household's categorisation is based on the

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[41] For example, the national statistics officer used East Kalimantan-related raw data of National Economic Survey to estimate the T.2 block of the Berau District SAM.

household's head occupation (e.g. whether the head of household occupation is a paid worker or a self-employee).

D. Final reconciliation and balancing

Result of the previous step is an unbalanced version of the social accounting matrix. This imbalance is a consequence of derivation of information using variety of approaches, different source of information and errors in estimation. A cross-entropy approach was utilised to balance the initial social accounting matrix table (Robinson et al., 1998; Robinson & El-Said, 2000).

5.2 Conclusion

Computable general equilibrium (CGE) analysis requires dataset in the form of input-output and/or social accounting matrix tables. The input-output depicts the interrelationship between economic agents i.e. producers and consumers within an economy and it is extended into a social accounting matrix by including factors income and wealth.

Various approaches available to construct a regional input-output table which range from full survey to pure non-survey methods. One of the existing non-survey techniques to generate a regional input-output table is a commodity balance approach which was developed by Kronenberg (2007). The technique includes estimating cross-hauling, defined as a simultaneous export and import of the same commodity, a feature that mostly occurs within an economy due, for example, commodity aggregation. To complete an input-output table into a SAM, required information can be obtained from a variety of sources including statistic officers' estimation.

Chapter 6 Preparing Dataset for CGE Modelling: Constructing the Berau District Social Accounting Matrix Table

This chapter outlines the methods of constructing the input-output and social accounting matrix tables, described in Chapter 5, for the Berau District, East Kalimantan Province.

6.1 Constructing the Berau District, East Kalimantan Province Input-Output Table

This section explains the application of the modified commodity-balance approach (see Chapter 5) to construct an input-output table for the Berau District, East Kalimantan Province, Indonesia. The 2007 East Kalimantan Province Input-Output Table serves as the basis for 'regionalisation' process to produce an estimate of the 2007 Berau District Input-Output Table.

In Indonesia, a national input-output table is usually constructed every five years and regularly updated by the National Statistics Office. However this is not the case for province or district levels, because constructing an input-output table requires a significant amount of expertise and financial resources. Thus the construction of 'regional' I-O tables sometimes relies on specific research or development projects occurring in the regions.

In the Berau District, East Kalimantan Province, for example, the latest publication of the District Input-Output Table available is the 1996 Input-Output Table, which was developed by the Berau District Statistics Office or Badan Pusat Statistik Kabupaten Berau (Kantor Statistik & BAPPEDA, 1998). A Berau District Input-Output Table was constructed in order to provide a basis for developing the District's social accounting matrix table, which will subsequently be used as database for a computable general equilibrium modelling.

Figure 6.1 explains in detail the process of deriving Berau District Input-Output Table using the 2007 East Kalimantan Province Input-Output Table. It basically summarises the Commodity Balance with Cross Hauling Approach (sections 5.1.2 of Chapter 5).

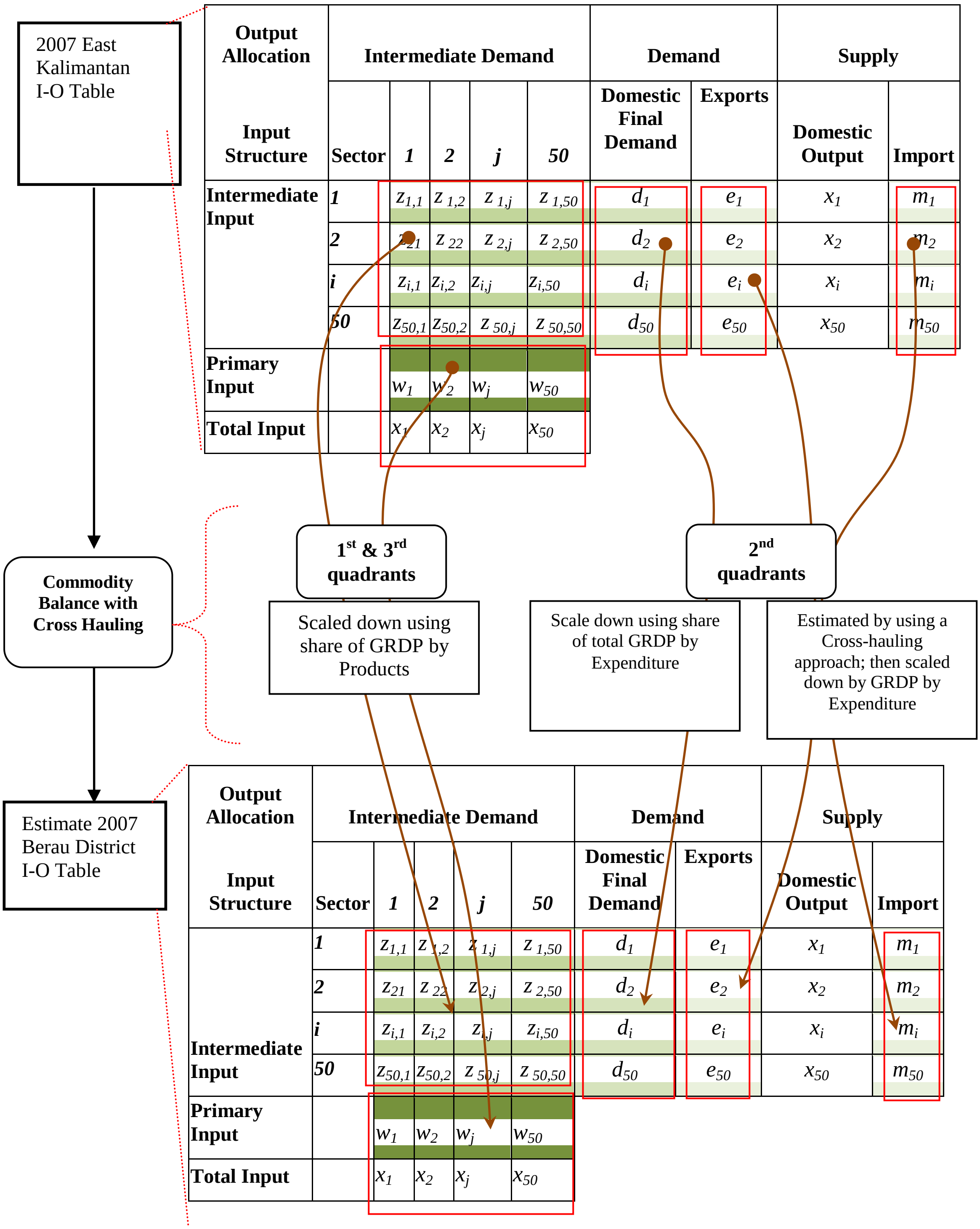

Figure 6.1 Deriving Berau District I-O Table using Commodity Balance with Cross Hauling Approach

6.1.1 The 2007 East Kalimantan Input-Output Table

The most recent (2007) East Kalimantan Province Input-Output Table, which consists of 50 sectors[42] (Badan Pusat Statistik & BAPPEDA Kalimantan Timur, 2008) was used. Within the publication, three types of East Kalimantan Province Input-Output Tables are available:

- the 2007 Total Transaction Input-Output Table based on Producers' Price,
- the 2007 Total Transaction Input-Output Table based on Purchasers' Price, and
- the 2007 Domestic Transaction Input-Output Table based on Producers' Price.

For the purpose of a constructing database for computable general equilibrium modelling[43], the 2007 Total Transaction Input-Output Table of East Kalimantan based on Producers' Price was selected. This is in accordance with type (a) of the definition of Gross Domestic Price (European Commission et al., 2009, p. 105). The input-output table then served as a parent table for deriving the Berau District Input-Output Table.

Compared to the 2007 East Kalimantan Input-Output Table, the 1996 Berau District Input-Output Table contains only 40 sectors. However, the 1996 Berau District Input-Output table has more detailed sectoral distribution in some sectors, such as forestry which was broken down into sectors of logs, swiftlet nests, and other forest products. The estate crop sector was also detailed into sub sectors of coconut, pepper, and others. The 1996 Berau District Input-Output Table, however, does not have oil palm or pulp and paper sectors. Sectoral distribution of the 2007 East Kalimantan Input-Output Table is shown in Appendix 6.1.

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[42] The Indonesia National Statistic Office publishes *Klasifikasi Baku Lapangan Usaha Indonesia* (or Indonesian Standard Industrial Clasification - ISIC) to guide the grouping of economic activities that have similarities in their processing, material and technology into the same sector. In the national and regional accounting system, the term 'sector' and 'industry' are interchangeable.

[43] This was based on discussions with Indonesian National Statistics Officers, during the first field visit which was conducted from January to May 2010.

6.1.2 Estimating the Berau District Output (Intermediate Transactions and Primary Inputs/Value Added)

Information on 2007 labour force survey collected in the Berau District was limited in sampling size since the survey was for national purpose, and was unable to be used for estimating the Berau District output. Therefore, information on sectoral domestic products, which is considered superior to the employment level data, was used. The 2007 sectoral domestic products data of both Berau District and East Kalimantan Province were obtained from the East Kalimantan Statistic Office. Next, share of the sectoral domestic products between the Berau District and the East Kalimantan Province was calculated and utilised to scale down the East Kalimantan Province‘s production output, in order to get estimates of the Berau District’s production output.

In 2007, the Berau District Statistics Office reported the domestic product of 37 sectors, while the East Kalimantan Statistics Office informed provided domestic product information on 50 sectors. Consequently, some Berau District sectors need to be disaggregated, as follow:

- *Agricultural Sector*

The Berau District domestic product of the agriculture sector was recorded as (IDR million) 131,322.69 in 2007. The sector domestic product value was disaggregated into into five subsectors: paddy, cassava, vegetables, fruits, and other foods. The values were distributed according to the proportion of labour working in those subsectors, assuming that employment levels correspond to the level of output for every sector. The 2007 National Labour Force Survey or Survey Tenaga Kerja Nasional or SAKERNAS 2007 provides information on employment levels in each of the subsectors.

- *Estate Crop Sector*

The domestic product of the estate sector of Berau District was Rp. 91,007.76 million in 2007. This sector was also split into sub sectors of pepper plantation, oil palm plantation, and other estate crops using data on employment levels in estate crops, which was derived from the Berau District Statistics Office, 2008 as well as from the East Kalimantan Estate Crops Agency, 2007[44].

- *Forestry Sector*

In the East Kalimantan Province Input-Output Table, the forestry sector is dissagregated into subsectors of log/timber and other forest products (non-wood products). The Berau District's forestry sector of Rp. 415,924.58 million was also disaggregated accordingly, by utilising the share of domestic products between log and non-wood products of the 1996 Berau District Input-Output Table. This suggests that the shares of domestic product of the logging sector and the non-wood/other forest products sector were 90% and 10% respectively.

- *Livestock and fishery*

The livestock and fishery sectors have also been disaggregated into their subsectors using information on labour working in those subsectors, assuming similar labour productivity. The disaggregation process and employment information source were similar to those of the agriculture sector.

Appendix 6.2 shows the sectoral distribution and the gross regional domestic products distribution of the Berau District and the East Kalimantan Province as well as the calculated share/ratio of sectoral domestic products distribution of the Berau District to the corresponding domestic products of the Province. Marine transportation and pulp, paper and printing sector had the highest and second highest shares/ratio of 0.341 and 0.259, respectively. The high share/ratio of the marine transportation sector was probably due to the Tandjung Jabung Port, the

[44] http://perkebunan.kaltimprov.go.id/potensi-9-kabupaten-berau.html visited 2010

main port linking the district to other regions. Meanwhile a high share of the pulp and paper and printing was due to the Kiani Nusantara Pulp and Paper Company, which is located in the District. The timber and the timber industry sectors' ratio were estimated to only be 0.119 and 0.002 respectively; while in the estate crops group, the shares of pepper plantation, oil palm plantation and other crops sectors were the lowest with only 0.024, 0.050 and 0.073.

Finally, those shares/ratios were utilised to scale down the intermediate transactions, primary inputs, and domestic products of East Kalimantan to produce estimates of Berau District's intermediate inputs z (row 1 to 190), primary inputs/value-added w (as in row 201 to 209), and domestic production x (row 210).

6.1.3 Estimating the Berau District's Final Demand (excluding Exports)

The Berau District's final demand excluding exports (consisting of both household and government consumption, capital formation/accumulation, and change in stocks), is set:

FD = C + G + I

where:

FD : Final Demand (excluding exports),

C : Household consumption,

G : Government consumption, and

I : Investment, which is a sum of capital formation and change in stock.

As suggested by Jackson (1998), share of the total final demand excluding exports was calculated using information on the total Berau District Final Demand and the East Kalimantan Province's counterparts. Table 2.4 provides the total Berau District final demand excluding exports and that of East Kalimantan Province, including the calculated shares. Those shares were employed to scale down the East Kalimantan Province final demand excluding exports. This process assumes that the structure of Berau District's final demand follows that of East Kalimantan Province.

Table 2.5 depicts the process of deriving the Berau District households' consumption from that of the East Kalimantan Province. The share of the Berau District households' consumption was 0.023 and this value was used to scale down the East Kalimantan Province household consumption. The Berau District's Government Consumption, Capital Formation/Accumulation, and Changes in Stock were estimated in a similar fashion.

Table 6.1 Share of Household and Government Consumption, Capital Formation, Change in Stock, Imports and Exports

No	Items	Berau District (in Million Rupiah)	East Kalimantan Province (in Million Rupiah)	Share
	(1)	(2)	(3)	(4)
1	Household consumption	733,432.10	32,073,591.02	0.023
2	Government consumption	353,089.35	11,965,400.87	0.030
3	Capital Formation & Change in Stock (Investment)	1,040,070.79	34,913,159.12	0.030
5	Export	3,027,025.39	220,374,308.12	0.014
6	Import	808,890.10	77,394,570.14	0.010
	Total Gross Regional Domestic Products	4,344,727.53	221,931,889.00	0.020

Source: Berau District Statistics Office

Table 6.2 The Berau District and East Kalimantan Province's Sectoral Distribution and Share of Domestic Products

No.	Sector	The East Kalimantan Households Consumption	The Berau District Households Consumption
	*Share of total *)*	*0.023*	
	(1)	(2)	(3)
1	Paddy	-	-
2	Cassava	135,989.25	3,105.43
3	Vegetables	1,139,139.38	26,013.26
…	…	…	…
50	Uncategorised Activity	-	-
	Total	32,073,591.02	733,432.10

6.1.4 Estimating the Berau District Trades (Exports and Imports)

Prior to calculating the Berau District's trade pattern, product heterogeneity was estimated by using information of the East Kalimantan trade figures. Subsequently, the product heterogeneity of East Kalimantan was used to estimate the degree of cross hauling of the corresponding commodity for the Berau District. However, the cross hauling of the Berau District is embedded within the process of calculating the Berau District trade volume. Once the District's trade volume, consumption and production have been calculated, Berau District's exports and imports can be estimated.

Finally all the estimates of z, x, d, e and m were then assembled to create a complete Berau District Input-Output Table. A (description of) Berau District Input-Output Table is shown in Table 6.5.

Table 6.3 Initial estimate of the 2007 Berau District Input-Output Table (x Rp. 1000.00)

Output Allocation	Intermediate Demand						Final Demand					Total Demand	Supply		Total Supply
Input Structure	Sector	1	2	…	50	180 (total intrmd dmd)	Household Consumption	Government Consumption	Capital Formation	Change in Stock	Export		Import	Output	
Intermediate Inputs	1	8,008,757	0	…	0	9,486,598	0	6,032.36	-	1,063,263	47,526,816	58,082,710	0	97,836,289	97,836,289
	2	0	562,113	…	0	694,585	3,109,688	-	-	38,077	14,430,880	18,273,231	0	30,343,872	30,343,872
	…	…	…	…	..	…	…	…	…	…	…	…	…	…	…
	50	0	0	…	0	0	0	0	0	0	0	0	8,817,475	0	0
Sum of Intermediate Inputs	**190**	**20,003,547**	**2,097,535**	**…**	**0**	**3,067,216,082**	733,432,100	353,089,350	883,486,940	156,583,850	3,027,025,390	8,243,386,508	7,427,138,779	808,890,100	8,236,028,879
Wages & Operating Surplus	**202**	**69,011,705**	**26,799,784**	**…**	**0**	**360,357,702**									
Depreciation	**203**	**1,984,433**	**14,559**	**…**	**0**	**179,236,876**									
Net Indirect Taxes	**204**	**6,836,604**	**1,431,993**	**…**	**0**	**0**									
Subsidy	**205**	**-**	**-**	**-**	**-**	**-**									
Sum of Primary Input ~ GRDP	**209**	**77,832,742**	**28,246,337**	**…**	**0**	**4,344,888,030**									
Output (Production)	**210**	**97,836,289**	**30,343,872**	**…**	**0**	**7,412,104,112**									

6.2 Constructing the Social Accounting Matrix of the Berau District, East Kalimantan

In the case where a previous social accounting matrix is available, a current social accounting matrix table can be obtained by updating the previous table i.e. inserting more recent information on some matrices and balancing the matrix. However, there is not any SAM of Berau District available. Consequently, the National Social Accounting Matrix 2005 and the Social Accounting Matrix of East Kutai District East Kalimantan 2000 were employed as a benchmark.[45] In this regards, the Berau District Social Accounting Matrix Table was constructed by adapting and modifying model of the 2000 East Kutai District East Kalimantan Province Social Accounting Matrix Table. All initial values of social accounting matrix table of the Berau District, East Kalimantan Province except cells that were derived from the input-output were estimated by officers of the National Statistics Office[46]. This section is presented to illustrate the process of constructing the Berau District SAM.

The Berau District Social Accounting Matrix Table was designed to consist of the following accounts:

(a) Factors of Production

Labour and capital are the factors of production represented in the model. The labour factor is divided into three groups:

- Forestry labour, which is further grouped into paid worker and non-paid worker categories;

[45] During a field visit in March 2009, an officer of the East Kalimantan Statistics Office revealed that in 2010, a Social Accounting Matrix of East Kalimantan would be developed. Yet, until November 2010, it was not available. Data collection phase of this research was closed off by end of November 2010.

[46] The Social Accounting Matrix of Berau District was prepared by Mr. Wisnu Winardi, Assistant Deputy Director at the Directorate of National Accounts, Indonesian National Statistics Office and his staffes. Mr. Winardi's extensive experience in working at the South Kalimantan Statistic Office provides an additional advantage.

- Agricultural labour, which is further classified into paid worker and non-paid worker categories, and
- Other types of labour, which consists of paid worker and non-paid worker categories.

The 2000 East Kutai District and 2003 East Kalimantan Province SAM Tables (Justianto, 2005) did not separate capital as a factor of production into land and capital. However, the 2005 Inter-regional Input-Output Table for Indonesia disaggregates the capital factors into land and capital and the shares can be used as a proxy to disaggregate land factor from the capital of the Berau District[47].

(b) Institutions

There are three types of institution in the district i.e. households, enterprise and government. The households was categorised into four groups. The enterprise and government institutions were not disaggregated.

- *Household Institutions*

Households was disaggregated into four groups i.e. Forestry households, Agricultural (excluding Forestry) households, Non-Agricultural households and Other type of households. Each household category, except for the Other type of household, was further divided into worker and self-employed category[48.] Overall, there are seven household types in this institution. Further households disaggregation was not possible because the sample size of the Berau District was limited (when 2005 National Social Economic Survey was constructed)[49].

- *Enterprise Institution*; includes all firms in the Berau District,
- *Government Institution*; refers to the Berau District government.

[47] Resosudarmo, B.P., Indonesian Researcher and a CGE modeller in Australian National University. email communications October 2011.
[48] Specified according to the head of the household’s job occupation.
[49] As was suggested by Mr. Wisnu Winardi, the National Statistics officers.

(c) Producing Sectors or Activities and commodities

Based on discussion with the National Statistics officer, the Social Accounting Matrix was designed to have 24 sectors. Sectors which are less relevant to the study were aggregated. Yet, important sectors such as food crops, estate crops, oil palm plantation, as well as timber sector were retained. This disaggregation is considered more detail than the 2000 Social Accounting Matrix Table of East Kutai District, East Kalimantan Province, which comprises only 13 sectors.[50] Furthermore, the number of commodities is similar to the number of sectors, assuming one sector produces only one commodity.

The following table shows the aggregation of 50 sectors into 24 sectors/commodities.

[50] The National Statistics officer suggested that to have higher number of sectors would be unreasonable because, at the district level, data were lacking to support such high level sectoral distribution.

Table 6.4 Aggregating 50 sectors into 23 sectors

No	Sector	Original sectors
1	Food and cash crops	Sectors 1-4
2	Oil palm plantation	Sector 6
3	Other estate crops	Sectors 5 and 7
4	Poultry & other livestock	Sectors 8-9
5	Timber/logging	Sector 10
6	Other (non-wood) forest products	Sector 11
7	Marine & inland fishery	Sectors 12-13
8	Coal, oil & natural gas, other non oil & natural gas mining	Sectors 14-16
9	Quarrying	Sector 17
10	Food and beverage industry	Sector 20
11	Textile, leather and foot-based industry	Sector 21
12	Forestry-based industry	Sector 22
13	Pulp and paper including printing industry	Sector 23
14	Fertiliser, chemical and rubber-based industry	Sectors 24
15	Other products industries, oil refinery, LNG industry, cement & its associations industry, steel industry, transport, machinery & tool industry	Sectors 25-28, and 18-19
16	Electricity & water	Sectors 29-30
17	Construction	Sector 31
18	Trade, hotel & restaurant	Sectors 32-34
19	Transportation	Sectors 35-39
20	Communication	Sector 40
21	Banks & other financial services	Sectors 41-42
22	Rentals & company services	Sectors 43-44
23	Other services	Sectors 45-48

Source: Author

(d) <u>Capital Accounts; also referred to as Saving and Investments</u>
(e) <u>Net Indirect Taxes</u>
(f) <u>Rest of the World (Berau)</u>

The rest of the world represents regions out of the Berau District, such as the rest of East Kalimantan, Indonesia, and out of Indonesia. This follows a single region social accounting matrix model of the East Kutai District 2000 and the Sumatra Island Social Accounting Matrix/CGE Model of Nu Nu San et al. (2000).

6.2.1 Specifying the Social Accounting contents

Before a detailed social accounting matrix table was constructed, an initial social accounting matrix table of 10 x 10, a slightly extended version of Table 5.2, was developed to provide a basis for the detailing process (see Table 6.5 and Table 6.6). Table 6.5 informs the meaning of each cell, while Table 6.6 shows value of each cell of the matrix. In both table, highlighted cells indicates that those data were obtained from the input-output table. The rest of the matrix was derived from variety of sources and was explained as follow:

- *Cells of the Social Accounting Matrix Table that are derived from the 24 sectors Berau Input-Output Table are:*

    a. Intermediate demand/input (T7.6)

    Intermediate demand (or intermediate input) includes purchases and uses of both domestic and imported good and services. This also includes trade and transportation margin values (BPS, 2008). Information of the intermediate demand was taken the intermediate demand of the aggregated version of the Berau District Input-Output Table containing 24 sectors. Hence, in the Berau District Social Accounting Matrix Table, they form a sub matrix of 24 x 24.

Table 6.5 Structure of the Aggregate SAM (a matrix of 10 x 10)

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
I. Factors of Production	Labour	1						Salary & Wages (Labour payment by industries) T1.6				Labour receipt from RoW T1.10	Labour Demand
	Capital	2						Non labour (Gross operating surplus) T2.6				Capital receipt from RoW T2.10	Capital Demand
II. Institutions	Household	3	Labour Income T3.1	Capital Income T3.2	Inter-households Transfer T3.3	Government Transfer to Household T3.4	Government Transfer to Household T3.5					Household receipt from RoW T3.10	Household Income
	Enterprise	4		Enterprise Capital Income T4.2	Household Transfer to Enterprise T4.2	Inter Enterprise Transfer T4.2						Enterprise receipt from RoW T4.10	Enterprise Income
	Government	5			Direct Tax from Household T4.3	Direct Tax from Enterprise T4.4	Inter Government Transfer T4.5				Government receipt from Indirect Tax T5.9	Government receipt from RoW T5.10	Government Revenue
III. Producing Sector		6							MAKE Matrix T6.7				Industry Sales
IV. Commodity		7			Household Consumption T7.3		Government Consumption T7.5	Intermediate Input T7.6		Investment T7.8		Exports T7.10	Total Demand
V. Capital Account		8			Household Saving T8.3	Enterprise Saving T8.4	Government Saving T8.5						Capital Formation
VI. Net Indirect Tax		9							Indirect Tax T9.7				Sum of Indirect Tax
VII. Rest of the World		10	Labours income transfers to RoW T10.1	Capital income transfers to RoW T10.2	Households transfers to RoW T10.2	Enterprise transfers to RoW T10.4	Government transfers to RoW T10.5		Imports T.10.7				Foreign Exchange Outflow
Sum			Labour Supply	Capital Supply	Household Spending	Enterprise Spending	Government Spending	Industry Cost	Total Supply	Total Investment	Indirect Tax Revenue	Foreign Exchange Inflow	

Sources: Wisnu Winardi (2010), personnal communication, modified from *Pusat Rencana Kehutanan Departemen Kehutanan & Direktorat Neraca Konsumsi Badan Pusat Statistik* (2001)

Notes:
- Values in the highlighted cells were derived from I-O table. Others were derived from a variety of sources.
- E.g. T3.1 refers to an intersection of Row 3 and Column 1.

Table 6.6 Initial Estimates of the Aggregate Berau District SAM (in million)

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
I. Factors of Production	Labour	1						1,630,768,400.83				2,591,571.59	1,633,359,972.42
	Capital	2						1,843,842,419.17				2,609,021.41	1,846,451,440.58
II. Institution	Households	3	1,593,972,694.98	345,740,634.16	128,900,448.06	49,683,256.21	36,434,387.89					3,501,525.09	2,158,232,946.39
	Enterprise	4		1,395,824,291.98	-	26,731,994.68						1,059,700.75	1,423,615,987.41
	Government	5			172,099,357.93	216,333,799.63	48,644,786.39				870,116,710.00	29,569,506.26	1,336,764,160.21
III. Producing Sector		6							6,564,379,623.55				6,564,379,623.55
IV. Commodity		7			733,432,100.00		353,089,350.00	3,089,768,803.55		1,040,070,790.00		3,027,025,390.00	8,243,386,433.55
V. Capital Account		8			160,419,261.80	430,044,060.42	100,818,698.16					348,788,769.63	1,040,070,790.00
VI. Net Indirect Tax		9							870,116,710.00				870,116,710.00
VII. Rest of the World		10	588,646,345.84	246,490,146.67	22,927,167.79	610,544,838.30	166,001,010.45		808,890,100.00	0.00			2,443,499,609.05
Sum			2,182,619,040.82	1,988,055,072.80	1,217,778,335.58	1,333,337,949.24	704,988,232.89	6,564,379,623.55	8,243,386,433.55	1,040,070,790.00	870,116,710.00	3,415,145,484.73	

Sources: Author’s calculation and Wisnu Winardi (2010)’s estimation, personal communication.

Note that values in the highlighted cells were derived from I-O table. Others were derived from variety of sources.

b. Labour payment by industries (T1.6)

This cell represents value added allocated to factors of production (labour and capital), which was taken from wage and salary, gross operating surplus and depreciation[51] sections of the input-output table. This transaction reflects returns for service paid by the producing sector and indicates the source of income for the factors of production and institutions (especially households).

In the Indonesian Social Accounting Matrix System, the labour factor of production consists of wages and salaries, i.e. actually represents formal paid workers. The informal workers e.g. unpaid family workers and self-employed workers are still accumulated in the gross operating surplus. For this reason, the value of the informal workers should be excluded and taken out of the operating surplus[52]. Included in the informal workers are unpaid family workers and the self-employed (Badan Pusat Statistik, 2008a).

In the Berau District Social Accounting Matrix Table, this labour factor of production was expanded into a sub-matrix of 6 x 24.

c. Gross operating surplus or non-labour payment by industries (T2.6)

The capital factor of production is estimated from net operating surplus (the gross operating surplus less the portion that has been taken out as imputed wages and salary). This forms a matrix of 1 x 24.

d. Net indirect taxes/taxes minus subsidy (T9.7)

Net indirect tax represents income to government, beside transfers from RoW to the government. In the SAM table, each net indirect tax forms a sub matrix of 1 X 24.

[51] Depreciation is assumed to be compensation from the capital factor of production.

[52] The return of service for informal worker was calculated in the form of imputed wage and salary.

e. Final Demand (T7.3, T7.5, T7.8, T7.10)

Final demand (consumption) includes goods and services purchased for capital government and households' consumption, capital formation (investment), and exports. Data for this final demand comes from the relevant sub matrices of the input-output table. In the Berau District Social Accounting Matrix Table, the households' consumption, government expenditure, capital formation (investment), and exports form sub matrices of 24 x 7, 24 1, 24 x 1 and 24 x 1, respectively.

f. Rest of the World (Berau District (T10.7)

This is a total of imported commodities required by both intermediate and final demanders. This forms a matrix of 1x24 and is derived imports sub matrix of the input-output table.

g. Make Matrix (T6.7);

Make Matrix is a matrix that reveals how industries supply commodities to the market. It is assumed that the matrix is diagonal meaning that every industry produces a single commodity.

h. Other cells – not included in the above points *a* to *g*. These are to be estimated from other sources such as:

- 2005 National Social Economic Survey (*Survey Sosial Ekonomi Nasional* or *SUSENAS* 2005)
- 2007 National Labour Force Survey (*Survey Angkatan Kerja Nasional*/ *SAKERNAS* 2007)
- Reports of the Berau District Government Expenditure of the year 2007
- Records of the East Kalimantan exports and imports of the year 2007
- Other information (Cash flow accounts, Indonesia National Bank, etc.)

Sometimes some cells are left as balancing items between accounts because such information is rarely available (Hosoe et al., 2010).

The rest of the social accounting matrix table cells are briefly explained as follows:

Table 6.7 Estimating the rest of Berau SAM accounts

Referred cells	**Remarks**
T1.10	Data were estimated using a share of the East Kalimantan exports and imports (intra-national and international) to the total East Kalimantan's GRDP, multiplied by salary and wage received by labour factor of production (of the producing sector/activities).
T2.10	Data were estimated using shares of the East Kalimantan Exports and Imports (intra-national and international) to total East Kalimantan's GRDP, and multiplied by capital income of the capital factor of production (of the producing sector/activities).
T3.1	Data were estimated from salary and wages received by the households using *SUSENAS* 2007.
T3.2	Data were estimated from capital income (from both agriculture and non agriculture) received by households using *SUSENAS* 2007.
T3.3	Data were estimated from transfers between households from *SUSENAS* 2007.
T3.4	As a balancing item
T3.5	Data were estimated using the 2007 Berau District expenditure reports. Central government accounts were used to detail this matrix using the District's account for social transfers timed by household consumption (of the input-output table).
T3.10	Data was estimated using share of the East Kalimantan imports and exports to the East Kalimantan's GRDP, multiplied by households consumption component of the Berau District's GRDP.
T4.3	Data were estimated using households' expenditure for insurance. The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to extend this District sub matrix.
T4.4	As a balancing item
T4.10	As a balancing item
T5.3	Data were derived from household expenditure for taxes (direct tax income). The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to extend the District sub matrix.
T5.4	As a balancing item
T5.5	Data were obtained from the Berau District government Expenditure 2007. The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to extend the District sub matrix.
T5.10	Data were estimated from share of the East Kalimantan exports and imports (intra-national and international) to the total East Kalimantan's GRDP, and multiplied by government consumption.
T8.3	As a balancing item
T8.4	Data on savings were obtained from the Indonesian National Bank of East Kalimantan Branch 2007. The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to form district the sub matrix.
T8.5	Data were derived from the Berau District, East Kalimantan and Central Government's Budget and Expenditure in 2007. The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to form the sub matrix.

Source: Wisnu Winardi, personal communication, 2010.

6.2.2 Balancing the Social Accounting Matrix

The initial social accounting matrix (SAM) table of the Berau District constructed by a National Statistics officer was inconsistent and unbalanced (characterised by the sum of some rows being unequal to the sum the corresponding columns) due to a variety of data sources and estimation techniques used to derive information of the SAM accounts. The matrix was adjusted to obtain its balance condition (i.e. sum of each row equals to the sum of each corresponding column). Table 6.8 demonstrates an aggregate version of the inconsistent SAM table (Robinson et al., 1998; Robinson & El-Said, 2000).

A cross entropy method (Robinson, Cattaneo, and El-Said, 1998; Robinson & El-Said, 2000) was utilised. The method basically is an optimisation approach (i.e. minimisation) of relative 'entropy' distance between two probability distributions (prior and posterior) using all information available at the problem at hand. In this context, the idea is to find a new set of (SAM) coefficients which minimise the relative entropy distance between prior and the new estimated matrix coefficients. The process retains some prior known information (i.e. data that have higher reliability such as the value of exports, imports, and private and government consumptions obtained from the District Statistics Office).

The result of the balancing process is presented in Table 6.8; while Table 6.9 presents the percentage change of each cell matrix from its initial values (as in Table 6.7). In those tables, all green cells indicate that values were taken from the IO table. In Table 6.9, zero percentage change occurs on cells which their values have been fixed during the balancing process, such as total household consumption (Note that initial values are retained since the sources are from published statistics). Rows 8 and 10, as well as column 10 have large percentage changes suggesting less accurate initial estimation or less reliable information. During the balancing process, all non-fixed cells are treated to have similar weight (e.g. no error estimate is given) since no information on error estimation is available.

Table 6.8 Aggregate Balanced SAM of the Berau District (x IDR 1,000)

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
I. Factors of Production	Labour	1						2,083,863,724.48				0.00	2,083,863,724.48
	Capital	2						1,390,747,095.52				0.00	1,390,747,095.52
II. Institution	Households	3	1,106,636,638.29	88,565,231.21	129,017,411.18	17,817,776.91	38,441,959.04					212,649.06	1,380,691,665.69
	Enterprise	4		1,049,594,042.25	-	21,852,891.47						767,128.17	1,072,214,061.89
	Government	5			208,506,955.33	146,003,106.67	113,488,404.04				870,116,710.00	12,029,153.77	1,350,144,329.81
III. Producing Sector		6							5,399,749,540.01				5,399,749,540.01
IV. Commodity		7			733,432,100.00		353,089,350.00	1,925,138,720.01		1,040,070,790.00		3,027,025,389.99	7,078,756,350.00
V. Capital Account		8			277,366,398.89	316,439,962.53	262,257,426.81					184,007,001.76	1,040,070,790.00
VI. Net Indirect Tax		9							870,116,710.00				870,116,710.00
VII. Rest of the World		10	977,227,086.18	252,587,822.06	32,368,800.30	570,100,324.31	582,867,189.92		808,890,100.00	0.00	-		3,224,041,322.77
Sum			2,083,863,724.48	1,390,747,095.52	1,380,691,665.69	1,072,214,061.89	1,350,144,329.81	5,399,749,540.01	7,078,756,350.01	1,040,070,790.00	870,116,710.00	3,224,041,322.76	

Sources: SAM Balancing output

Table 6.9 Percentage Change from Initial Aggregate Berau District SAM (in %)

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
I. Factors of Production	Labour	1						28%				-100%	28%
	Capital	2						-25%				-100%	-25%
II. Institution	Households	3	-31%	-74%	0%	-64%	6%					-94%	-36%
	Enterprise	4		-25%	0%	-18%						-28%	-25%
	Government	5			21%	-33%	133%				0%	-59%	1%
III. Producing Sector		6							-18%				-18%
IV. Commodity		7			0%		0%	-38%		0%		0%	-14%
V. Capital Account		8			73%	-26%	160%					-47%	0%
VI. Net Indirect Tax		9							0%				0%
VII. Rest of the World		10	66%	2%	41%	-7%	251%		0%		-		32%
Sum			-5%	-30%	13%	-20%	92%	-18%	-14%	0%	0%	-6%	

Sources: SAM Balancing output

6.3 Conclusion

Unlike the input-output (IO) and/or social accounting matrix (SAM) of national level which are available and regularly updated, those of the district level are rarely available, as in the case of the Berau District East Kalimantan Province Indonesia. Consequently, the District's SAM table was constructed following Kronenberg (2007)'s cross-hauling approach. The chapter also demonstrated multiple ways of obtaining information including through statistics officers' estimation and verifying the collected information during the development the Berau's SAM table.

Chapter 7 Social Accounting Matrix of the Berau District

Chapter 7 provides further detail of the estimate of the 2007 Berau District Social Accounting Matrix (SAM). To facilitate the exposition, the SAM is decomposed into sub matrices which present the supply and demand sides of the economy. The exposition would be elaborated by relevant published information.

7.1. Structure of Production

The Berau District SAM consists of 23 sectors/commodities and each sector requires primary inputs (labour, capital, and land) and intermediate goods (consisting of locally produced and imported commodities) in their production activities. The share of inputs required to produce a unit of activity output is presented in a form of input-output coefficient, (Appendix 7.1). In this way, the table describes the factor intensity and intermediate intensity (i.e. the use of one commodity relative to other commodities to produce a unit of output). A sector may be intensive in the intermediate and factor inputs whose inputs-output share are relatively high (Burfisher, 2011; p.108).

Appendix 7.1 reveals that agricultural activities in the District are mostly labour intensive with the labour share ranges from 39% to 56%. Other forest product sector (OFOP) has highest share of labour and oil palm (OILP) has the lowest. Share of the labour in food crops (FCRO), other estate crops (OESC), and fisheries (FISH) are similar (50%). Meanwhile, Livestock (LIVS)'s labour share is 44%, higher than OILP but lower than others. In the agricultural group, capital share ranges from 20% to 37%. With relatively small land factor shares, intermediate inputs share in the group are between 13% and 37%.

Labour's share in the manufactures group varies from 11% to 49%. The shares of labour and capital are relative high in coal mining (COAL) and quarry (QUAR) activities, see columns 8 and 9 of the Appendix 7.1. The sectors in the manufacturing group generally have lower shares of labour and capital; and consequently they require higher levels of intermediate inputs (ranging from 57% to 87%).

Appendix 7.2 shows the value shares of labour, capital, and land inputs to total primary inputs within the 23 activities in 2007. In general, the service group has highest labour-capital ratio compared to the other two groups (2.23). Meanwhile, manufacturing industry in the Berau District in average has higher labour-capital ratio (1.88) than agriculture activity (1.76).

7.2. Structure of the Regional Supply and Economy

Structure of the Berau Supply

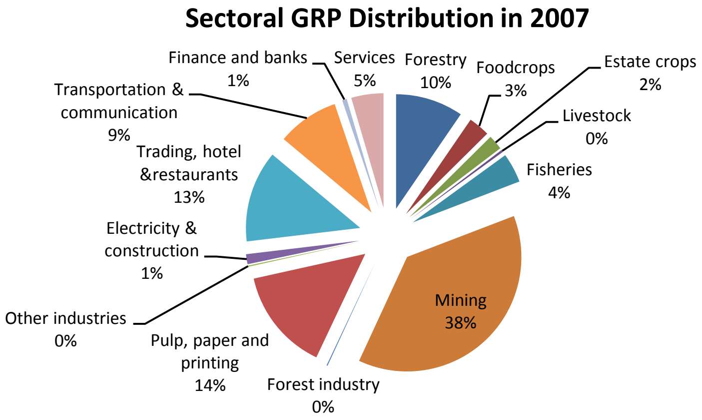
Regional supply of commodities comprises locally-produced and imported commodities. As indicated in the last row, col. 7 of Appendix 7.3, nearly 20% of the commodities demanded by the Berau District are supplied from outside (imported). The column also tells that Berau imports are dominated by manufacturing products. For instance, in, 90% of the food and beverage (FBIN) commodity consumed in the District comes from imports (see the FBIN row, col. 7, Appendix 7.3). However, the value of the imported FBIN commodity is only 10% of the District's import value (see FBIN row, col. 5 of Appendix 7.3). In the District, 97% of the consumed commodity oil refinery (OILR) commodity is also imported and its importation share is approximately 60% of the total imports (see the OILR row, cols. 7 and 5 of Appendix 7.3). High ratio of import to total consumption are also found in goods of other estates crop (OESC), textiles (TEXL), fertiliser and chemical products (FERC), finances (FINA) and services (SERV).

Column 3 of Appendix 7.3 informs share of goods in the Berau supply in 2007. The District's consumption of TIMB, COAL, PAPR, OILR, TRAD and TRAN goods/services are relatively high. Share of those commodities' value are 6.37%, 13.18%, 12.39%, 12.05%, 16.32%, and 10.88% of the total regional supply.

Consequently, the contribution of other commodities to total regional supply is relatively low.

Structure of the Berau's Economy

Figure 7.1 demonstrates the structure of the Berau structure of economy. In 2007, its economy was dominated by coal mining with its gross regional product (GRP) equals 37.50% of the total District's GRP. Forestry (logging and non-timber activities), Pulp and Paper (PAPR) and wood-based industries' output were respectively 14.5%, 10% and 0.14% of the District's GRP. Trading, hotel and restaurants (TRAD) activity contributes 11% of the economy total GRP) while Transportation and communication sector accounts for 9% of the economy. Further details can be seen in col. 1 Appendix 7.3.



Source: Social Accounting Matrix of the Berau District, 2007

Figure 7.1 The Berau District's sectoral GRP distribution in 2007

More than half of the total output of the Berau District is exported, as shown in last row of col. 6, Appendix 7.3. The coal sector exports 88% of its production. Very high export-output ratios are also found in OILP (82%), OESC (80%), FISH (78%), and PAPR (69%) activities. Meanwhile, TIMB and TRAN are noted to export 49% and 43% of their respective output. COAL's share to total Berau exports is the highest (48%); followed by PAPR (26%), TRAN (7.6%) and TIMB

(5.87). Interestingly, despite the high export-output ratio in OESC (80%), the export share of this commodity to total Berau exports is only 0.86%; suggesting that the OESC's output share is relatively small to other sectors' output value.

7.3.Household, Government and Investment

The Berau District SAM recognises 7 type households (see section 6.2 point b. Chapter 6). Most households in the District have labour returns as their main income (as depicted in Table 7.1). Earning from agricultural paid-labour (LAP) represents the largest share in both forestry worker (HFW) and agricultural (non-forestry) worker (HAW) households' accounting for 43% and 28%, respectively. Share of non-paid labour returns in forestry self-employee (HFSE) and agriculture (non-forestry) self-employee (HASE) households are 44% and 35%, respectively.

Table 7.1 Share of Households' Income Inflows

Items	Share (%)						
	HFW	HFSE	HAW	HASE	HNAW	HNASE	HOTH
	(1)	(2)	(2)	(3)	(4)	(5)	(6)
Factors Income	***90.68***	***86.77***	***66.65***	***86.89***	***81.37***	***88.32***	***100.00***
- LAP	42.76	9.55	28.40	21.09	2.26	2.06	5.29
- LANP	16.84	44.03	11.35	35.31	4.06	11.06	18.36
- LNAP	24.28	19.82	21.92	17.54	54.22	47.65	42.54
- LNANP	5.47	9.74	3.79	9.75	14.68	18.54	25.80
- CAP	1.31	3.59	1.18	3.15	6.12	8.97	7.97
- LAND	0.02	0.05	0.01	0.05	0.03	0.04	0.04
Transfers:	***9.32***	***13.23***	***33.35***	***13.11***	***18.63***	***11.68***	***-***
- from other households	6.83	9.36	22.81	9.68	12.97	7.81	-
- from Enterprise	0.81	1.23	3.28	1.13	1.79	1.19	-
- from Government	1.66	2.60	7.17	2.30	3.85	2.66	-
- from ROW	0.02	0.04	0.09	0.01	0.02	0.01	-
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Social Accounting Matrix of the Berau District, 2007

Households also receive transfers from other households, enterprise and government. Share of the transfers vary between households category ranging from 9% to 33% out of their income. Transfers from other households have the largest portion within each household group's transfers.

Table 7.2 Share of Households' Income Outflows

Items	Share (%)						
	HFW	HFSE	HAW	HASE	HNAW	HNASE	HOTH
	(1)	(2)	(2)	(3)	(4)	(5)	(6)
Tranfers	***50.13***	***61.33***	***66.53***	***26.96***	***25.15***	***26.66***	**-**
- other households	19.98	24.71	25.87	9.67	8.22	8.85	-
- ROW	2.74	2.71	5.32	2.39	2.97	2.12	-
- Gov. (as direct tax)	27.41	33.90	35.34	14.90	13.95	15.69	-
Total Consumption	***49.20***	***37.53***	***30.26***	***66.35***	***54.82***	***46.08***	***62.72***
- foods	21.98	18.23	15.76	27.87	14.14	12.77	8.35
- non foods	27.22	19.30	14.50	38.49	40.69	33.31	54.36
Saving	***0.67***	***1.14***	***3.21***	***6.69***	***20.03***	***27.26***	***37.28***
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Social Accounting Matrix of the Berau District, 2007

Table 7.2 shows the share of the Berau households' expenditure, which is divided into two categories of consumption and other expenses. The table shows that the agricultural household spends relatively a larger share of its income for transfers; while non-agricultural household's biggest expenditure is on consumption. The table also indicates that households' spending on non-food is generally higher than expenses on food.

The Berau District government's income from taxes includes the indirect and direct taxes accounting for 70% and 19%, respectively. The direct tax is paid by both households and enterprise and the indirect taxes are mainly from sales tax. The Government of Berau, however, spends the large portion of income on transfers to rest of world (47%). The government consumption and saving expenses are approximately 30% and 21%, respectively (see Table 7.3).

Investment in the District is mostly financed by savings of domestic entities. Share of household, enterprise, and government to total investment are 27%, 30%, and 25%. Rest of world contribute to about 18% of total savings.

Table 7.3 The Berau Government's income and expenditure

Expenditure	Share	Income	Share
Tranfers to:		Transfers from:	
- Households	0.03	- ROW	0.01
- ROW	0.47	- Households (direct tax)	0.17
Consumption	0.29	- Enterprise (direct tax)	0.12
Saving	0.21	Indirect Taxes	0.70
	1.00		1.00

Source: Social Accounting Matrix of the Berau District, 2007

7.4.Conclusion

The 2007 Berau District's social accounting matrix (SAM) exposes the district's structure of regional production, consumption and economy in a whole. Based on the SAM, agricultural sectors of the District are more labour intensive than manufacturing sectors. However, despite the fact that the manufacturing activities are less labour intensive, they also require more intermediate inputs -- rather than primary inputs -- than the agricultural activities do. Meanwhile, the Berau District can fulfil most of its demand and only 20% of that comes from outside of the District (imported) and out of the total import, it is dominated by manufactured commodities. In addition, the District economy is mainly contributed by mining sector. It is followed by pulp, paper & printing and trading, hotel, & restaurants sectors. Forestry sector contributes to about 10% of the District's economy. Combining the forestry with other agricultural activities, their contribution reaches to about 20%.

Chapter 8 Policy Scenario Development

This chapter aims to answer the first two research questions established in Chapter I concerning ways to estimate responses of the participants in the Berau emissions programme. Such questions were reshaped into two: costs and incentive levels associated to the selected participants contributing in the Program. The chosen parties are logging and oil palm companies as important contributors to the Berau emissions. A survey of experts' opinion was developed and relevant experts were asked to estimate the costs and incentive level required to compensate for the companies' contribution. Information from the related experts was aggregated and formulated as such to input to the Berau CGE model.

8.1 Brief Literature Review

Payment for Environmental Services (PES)

Land users usually provide a range of environmental services such as biodiversity of conservation and carbon sequestration (Pagiola et al., 2005). A "Payment for Environmental Services", or PES policy has been introduced to compensate individuals or communities for carrying out actions that increase the provision of ecosystem services such as water purification, flood mitigation or carbon sequestration e.g. through tree planting (Jack, Kousky, & Simsa, 2008). Typically payment of such incentives is conditional on service providers changing their behaviour by engaging in a particular programme which generates quality improvement in the environmental services. Pagiola et al. (2005) further identify two important aspects of the PES from the perspective of potential impacts on poverty. They are (i) that payments made under the PES programme are for land users and (ii) PES programmes are voluntary and participants receive payments for carrying out the activity.

There have been many applications of PES schemes across the world, from conservation themes and tree planting to the land rehabilitation context (Zanxin &

Ying, 2010); either in developed or developing countries (see reviews by Wunder et al., 2008). Examples of PES implementation are those in Costa Rica, Nicaragua, Columbia, and Guatemala (Pagiola, 2008; Pagiola, Rios, & Arcenas, 2010). In Indonesia, there are several PES programs, such as incentives for watershed management in Lake Cisadanau West Java (Leimona, Pasha, & Rahadian, 2010) and programmes for rewarding the upland poor in Asia for environmental services (RUPES) in Singkarak West Sumatera i.e. for carbon sequestration. Other PES programmes include water protection in Lake Toba North Sumatera and developing a market for biodiversity in Meru Betiri National Park East Java, (Suyanto, Leimona, Permana, & Chandler, 2006).

REDD as PES

The objective of REDD programmes is generally to compensate people to keep their forest and reduce greenhouse gas emissions[53]. The compensation may cover payments at individual and community levels (Jagger, Sills, Lawlor, & Sunderlin, 2010). Compensation or incentives may be in the form of cash or financial transfer, or other benefits for good practices, developing alternative livelihoods, formalising land tenure and local resources rights and intensifying productivity on non-forest lands (Wollenberg & Springate-Baginski, 2010).The incentive of avoiding deforestation is considered as part of Payment for Environmental Service /PES (The Economist, 2010).

On the one hand, REDD incentives contain some similar characteristics to previous PES schemes such as being based on ecosystem services, addressing the problem of externalities and contingent cash transfers (Martin, 2010). On the other hand, the REDD incentives differ from the existing PES Scheme, since the incentives reward the recipients for ‘not doing’ activities that generate carbon emissions (Martin, 2010). The level of willingness to accept compensation (incentives) should be assessed in order to discover whether the land

[53] See for example http://www.recoftc.org/site/What-is-REDD

users/holders/owners are willing to move away from emitting activities (Wunder, in Martin 2010).

A study by Indonesia Forest Climate Alliance (IFCA) recommends the following possible complementary scenarios, for REDD-related PES in Indonesia: (i) incentives for concession holders to practise reduced-impact logging (RIL) and/or forest certification; (ii) livelihood enhancement programmes (e.g. building on integrated conservation and development experiences) to reduce encroachment and illegal logging; (iii) environmental service-type payments for entrepreneurial measures that increase carbon sequestration; as well as (iv) provision of incentives to redirect planned oil palm or other estate crops to degraded lands and/or improve the management of oil palm plantation or Best Practice Management program (Ministry of Forestry, 2008).

8.2 Reduce-impact logging (RIL) as a measure to reduce emissions in the BFCP Program

Origin and definition of RIL

According to Dykstra (2012), the term 'reduced-impact logging' appeared in the LA Times in 1992, following promotion of a project in Tawau, Sabah, financed by the New England Electric System (NEES), an electric engineering company, to obtain experience with carbon offset forestry. Later, the reduced-impact logging (RIL) received greater acceptance from the environmental community compared to alternatives like 'environmentally sound forest harvesting', as termed in Dykstra and Heinrich (1992) or 'low impact logging', because it refers to 'reduced impacts' compared to conventional logging (Dykstra, 2012).

In forestry, logging and harvesting are now interchangeably used. The former usually refers to the narrow activity of felling and extracting timber from forests, while the latter suggests activities from pre-harvest planning, technical supervision and post-harvest assessments that resemble concern for non-timber resource values and sustainability of the forests (Dykstra, 2002). Reduced-impact logging (RIL) has many definitions. For example, Elias et al. (2001) states that

‘RIL is a systematic approach to planning, implementing, monitoring and evaluation logging’ (Elias et al., 2001). FAO (2004) formulated the RIL definition based on Bull et al. (2001) and Killman et al. (2002) as follows:

> “Intensively planned and carefully controlled implementation of harvesting operations to minimise the impact of forest stands and soils, usually in individual tree selection cutting”

FAO (2004), page 2.

Despite its variations due to local conditions, activities of RIL generally consist of the following (Dykstra, 2002; Food and Agricultural Organization, 2004; Sist, Sheil, Kartawinata, & Priyadi, 2003):

- *Pre-harvesting activities* which may include carrying out inventory and mapping of individual trees, planning of roads, skid trails and landings to provide access to the harvest area and to the individual trees scheduled for harvest while minimizing soil disturbance and protecting streams and waterways with appropriate crossings, and vine cutting in areas where vines bridge tree crowns. Additional works in this stage are constructing roads, landings and skid trails so that they adhere to engineering and environmental design guidelines;
- *Harvesting activities* which comprise felling and bucking techniques, including directional felling, cutting stumps low to the ground to avoid waste, and optimal crosscutting of tree stems into logs in a way that will maximize the recovery of useful wood. The stage also involves winching logs to planned skid trails and ensuring that skidding machines remain on the skid trails at all times, where feasible, utilizing yarding systems that protect soils and residual vegetation by suspending logs above the ground;
- *Post-harvesting activities* which include conducting post-harvest assessments in order to obtain feedback to the concession holder and logging crews and to evaluate the degree to which RIL guidelines were applied successfully.

RIL and Forest Certification

FSC guidelines and criteria do not specifically mention reduced-impact logging. However, RIL is recognised as a requirement for forest certification by certifiers who operate in rotational management regimes which are commonly applied to forest harvesting in the tropics. RIL compliance can contribute to achieving FSC certification, but this relies to an extent on what is included in the activity of RIL, as RIL activities may vary due to geographical conditions. In Indonesia, there are a large number of areas where RIL overlaps with the FSC principles and criteria (Klassen, 2006). Hence the application of RIL is usually considered as a means to achieve forest certification.

Obstacles in applying RIL with reference to Indonesia

According to Suparna (2006) forest companies in Indonesia are reluctant to engage in RIL, because for RIL to effectively operate requirements and preconditions are needed, and the forests management unit finds it more beneficial to avoid those preconditions. Such requirements and preconditions are 'data transparency, inflexibility in cutting block allocation, sustainable business commitment, willingness to reduce annual allowable cut in certain conditions'.

Further obstacles to adoption of RIL techniques identified by Suparna (2006) are:

- RIL is considered a "big new project" which is difficult and expensive to implement;
- Often some activities such as felling, skidding, and hauling are contracted out to other parties. Ensuring that they follow the RIL would mean higher contract costs.
- In the full RIL system, there are several additional tasks that must be carried out by the chain saw operator or the skidding operator compared with conventional practices. These additional activities imply additional cost. If the management is not convinced that this additional cost is less than its economic benefit, then full adoption of RIL might be a problem as well.

- There is often still a lack of trained personnel, who are necessary for activities such as inventory activity, and tree and contour map making.

These constraints seem to suggest that implementing the RIL would be relatively more costly compared to conventional practices. This is supported by other studies suggesting that financial return from implementing RIL practice varies from negative to ‘acceptable’ financial returns. For some cases, conventional logging is more profitable, particularly when logging activities occur at the area where previous logging took place (Priyadi, Gunarso, Sist, & Dwiprabowo, 2006).

Is RIL more costly than conventional logging (CL)?

Applegate (2002), Natadiwirya and Matikainen (2002) and Dwi Prabowo et al. (2002) carried out studies on cost-benefit of RIL implementation in Indonesia. However, the cost comparison analysis between the RIL and CL carried out by those authors did not take into account all elements of the RIL technique. For example, Applegate (2002), owing to limited data, only observed the skidding and skidding–related activities when comparing RIL and CL, and found that the logging cost of RIL was lower than that in the CL. Based on other observations; Applegate (2002) further suggested that the RIL costs relatively more than CL when activities beyond skidding are included.

A study conducted in Malaysia, revealed that the RIL technique generates incremental costs up to 57% more (in terms of cost per m3) or 47% more (in terms of cost per ha) compared to conventional logging (Samad, Othman, & Ashhari, 2009). The difference seems to be attributed to the use of the “log fisher” machine, i.e. a modified excavator with crane and winch attached (see Table x). According to this study, unless complemented by carbon credits and/or premium price for logs extracted, implementing RIL would not be profitable (produce negative return). A previous study by Tay et al. (2002) in Malaysia also suggests that RIL is less profitable because of the high costs of RIL, mainly because of requirement to reduce the volume per hectare extracted prescribed by the RIL.

Table 8.1 Cost Comparison between ’Logfisher’ logging (RIL) and Conventional Logging (CL) in Malaysia

Activities	Logfisher Practice (RM/m3)	Conventional Logging (RM/m3)
Pre-felling		
- Pre-felling inventory of trees, boundary, road alignment, tree tagging and road planning.	13.21	12.32
Felling		
- Road construction, felling & bucking, skidding,	176.91	140.68
- Log loading, short distance haulage, log yard		
- Administration, royalty, cess and premium		
‘Logfisher’	60.11	0
- Others	17.57	17.23
- Total	267.8	170.13
- Foregone revenue from buffer areas	27.63	27.62
Grand total	295.44	197.76

Source: Samad, Othman, and Ashhari, 2009

Medjibe and Putz (2012) reviewed cost comparisons between RIL and conventional logging in the tropics. Among the 10 cases they observed, they reported that in terms of profitability, per m3: four cases suggested that CL is less profitable, in two cases CL equalled RIL, and four cases showed that RIL was more profitable than CL. With regard to costs (per m3), they found that in six cases, CL was less expensive than RIL, including a study in East Kalimantan Indonesia; in one case there was no difference between the costs of RIL and CL; and three cases showed RIL to be cheaper than CL. Furthermore, the authors also observed that RIL activity in Gabon was more costly than CL, suggesting cost structures between the CL and RIL are as in the following Table.

Table 8.2. Cost Comparison between CL and RIL in Gabon (US$/m3)

Logging phase	Activities	Conventional Logging (US$/m3)	Reduced- Impact Logging (US$/m3)
Pre harvest	- Boundary demarcation	0.00	0.84
	- Pre felling inventory	0.00	1.40
	- Tree hunting	0.51	0.00
	- Training	0.00	0.14
	- Tree marking & mapping	0.00	0.43
		0.51	*2.81*
Harvest	- Felling & bucking	0.68	1.65
	- Skidding	1.48	1.63
	- Log deck operation	1.75	2.19
		3.91	*5.47*
Subtotal		**4.42**	**8.28**
Others	- Royalty	10.80	10.80
	- Area tax	1.36	0.65
	- Administration fees	1.08	1.17
Subtotal		**13.24**	**12.62**
Grand total		***17.66***	***20.90***

Source: Medjibe & Putz (2012)

In summary, the literatures suggest that the impact of the application of RIL on logging costs remains inconclusive. However, there seems a general perception that applying the RIL would cost more than the CL practice. As previously illustrated, the impact of RIL's incremental costs may range from producing negative returns to generating less profitable production. For the latter, this was supported by new prescriptions that, for the sake of sustainability, implementing the RIL application should be complemented with limiting the amount of trees being cut. For example, in East Kalimantan where the density of harvestable trees is more than 10 trees/ha, selective cutting based on a diameter limit of 50 cm and above would lead to excessive cutting. Applying the RIL should reduce the number of trees to be cut to less than 8 trees/ha in order to ensure not only regeneration and growth of residual stands, but also the long term ecological sustainability of forests (Priyadi & Kanninen, 2009; Sist et al., 2003).

Because of the variations in the RIL's potential impacts on logging costs, an experts' opinion survey was conducted to obtain an aggregate estimate of RIL's relative impact on logging costs with regard to the Berau District/Indonesian context. The experts were also asked to directly estimate the incentives level either per unit of management (ha^{-1}) or per unit of production (m^3) that should be compensated for contributing to emissions reduction through implementing the RIL in the logging practice.

8.3 Experts Elicitation

Decision-makers usually rely on pertinent data and information to support them in making accurate decisions. However, such prospective information is typically unavailable or insufficient and the decision-makers have to turn to alternative data. Expert opinion is recognised as a potential source of data and is often utilised to fill data gaps and/or supplement the trial and observational data.

Flandoli et al. (2011) define expert elicitation as 'a synthesis of opinion of experts on a subject where there is uncertainty due to insufficient data, when data is unobtainable because of physical constraints". James et al. (2010) state that 'expert elicitation is the process of retrieving and quantifying expert knowledge in a particular domain'. They further assert that 'such information is of particular value when the empirical data is expensive, limited or unreliable'. According to Runge et al. (2011) 'expert elicitation is a large and mature field of study in itself … with a growing body of methods for robustly and efficiently eliciting and combining judgments from experts'.

The use of the expert elicitation technique is increasing (Sullivan & Payne, 2011) and its use can be widely found in many areas such as teaching studies, health, economics, conservation management as well as other environmental sciences. Available methods for expert elicitation techniques are the Delphi method (Powell, 2003; Sullivan & Payne, 2011)including its variant such as the Nominal Group Technique (see Delbecq et al. (1975), cited by Runge et al. (2011) and the common Expert Survey Method/ESM (Gunton, 2002).

In the area of natural resources management, the expert opinion survey was also used to identify techniques for restoring Tallgrass prairie in North America (Rowe, 2010) and to estimate benefit transfers of environmental goods (León, Vázquez-Polo, & González, 2003), to assess preferences of priorities in animal conservation programmes (Fadlaoui, Roosen, & Baret, 2006) and to rank threats to endangered species of sea turtles (Donlan, Wingfield, Crowder, & Wilcox, 2010). Kuhnert et al. (2010) showed the use of expert elicitation to inform ecological models and support conservation decision-making. In the area of economics, Gabre-Madhin and Haggblade (2004) used the technique to identify and review successes in the African agriculture sector. Meanwhile Kerr et al. (1996) employed the expert‘s judgment for risk assessments (Kerr, 1996).

Equal versus un-equal weight?

Yetton and Bottger (1982) stated that it is generally accepted that a group’s performance is a positive function of the group members’ ability. A superiority of group performance over individual is due to greater resources and more creative process (within the group). An aggregation of several judgments is in accordance with an old saying that ‘two heads are better than one’ which emphasises the importance of collective judgment for making decisions. Usually, experts’ judgment upon a particular problem is aggregated by employing an equal weighting method. That is, aggregate information is calculated by a simple average of individual information (Hammitt & Zhang, 2012; Slevin, Boone, Russo, & Allen, 1998). However, Yetton and Botgger (1982) stated that an improvement in the quality of the decision (or the aggregation) can be obtained through ‘weighting more heavily those individual opinions expressed by more experts or skilled group members’. Dalkey (1969) and Dalkey et al. (1979) as cited by Slevin et al. (1998) also suggested that involving confidence estimates of individuals in providing judgment improved the accuracy of decision results.

Furthermore, Ashton and Ashton (1985) from their study indicated that aggregating experts’ judgment using different weighting produced accurate information compared with using equal weighting(Alison Hubbard & Ashton, 1985). A most recent experiment by Hammit and Zhang (2012) found that aggregating experts’ opinions by using equal weight performs worse than unequal-weight methods.

8.4 Expert Survey Method

Several experts whose knowledge and/or (working) experience are relevant to logging practice or forest management was interviewed and asked to answer the prepared questionnaire. A mixed technique of direct interview, drop and pick up, and email, was used to obtain the experts' judgment due to geographic location of the experts and longer time required to finish the questionnaire.

Collected opinions were aggregated by employing a 'simplified version' of the CONFIDE method which was adapted from Slevin et al. (1998). The approach exhibits some benefits such as (i) its ability to achieve a group's decision with no face-to face interaction, and (ii) using its algorithm, it allows decision makers to differently weight the contribution from members according to the confidence with which each member holds to their opinions. Hence, this leads to an increase in efficiency by replacing the lengthy ineffective group discussion, from the decision quality point of view (Slevin et al.,1998).

The term 'simplified' means that, due to time, scoping, and geographical constraints of involved-experts, the conducted process was a reduced form of the original technique used by Slevin et al. (1998). For example, in the original method, a group discussion was utilised to arrive into assigning weight values, while in this study, weight values or scales are subjectively assigned. The study emphasises presentation of processes and results of aggregating experts' judgment using both equal and unequal weights of confidence, nonetheless.

The 'simplified' CONFIDE is formulated as follows:

$$Rc = \sum_i E_{ij} \frac{C_{ij}}{D_j}$$

where Rc denotes the vector of final estimates obtained by a normalised confidence weighting of individual estimates, E_{ij} denotes estimates of individual *i* concerning issue *j*, C_{ij} denotes confidence in E_{ij}, and $D_j = \sum_i C_{ij}$.

Meanwhile, the simple averaging of group estimate is calculated as follows:

$$Ra = \frac{1}{n}\sum_{i} E_{ij}$$

where Ra denotes the vector of final estimates obtained by a normalised confidence weighting of individual estimates, *n* represents the number of individuals in the group and E_{ij} denotes estimates of individual *i* concerning issue *j*.

8.5 The Survey

The survey was carried out from 1 February to 30 March 2012. Respondents were relevant experts ranging from local and central government officers, representatives of logging companies, and pertinent researchers. It is worth noting that, although the focus of the study was the Berau District, the experts being interviewed were not necessarily located in the District.

8.6 Results and Discussion

Profile of Experts

For the purpose of the study, experts were identified, contacted and appointments were made. To reduce the bias of opinion, it was advised not to pick experts from a similar group, e.g. experts who have worked together on a certain project. Sufficient information regarding the study was also provided to each respondent (prior to filling out the form). In some cases, meeting with respondents was difficult to hold. Therefore, the questionnaire was emailed and respondents filled it in and returned it the same way.

Experts' responds to questionnaire are presented in Table 8.3. Thirteen sets of questionnaire were sent to the identified experts. Seven experts returned the questionnaire but one of them was not usable (non-completed) and six respondents gave no replies. Hence, the usable returned questionnaire is more about 50% out of total questionnaire being sent.

Table 8.3. The Group’s response to questionnaire

No. of Questionnaire sent	Returned Questionnaire		No return
	Usable	Non-usable	
13	6	1	6

Source: Author calculation

Respondents' institutional backgrounds are government agencies, educational institutions, non-governmental organisations (NGO) and companies (or practitioners). The largest portion of respondents came from NGOs, accounting for 50%. This is followed by those from educational institutions (33%) and companies /practitioners (17%), see Figure 8.1. The government agencies did not appear since there is not any reply from the respondent with this affiliation.

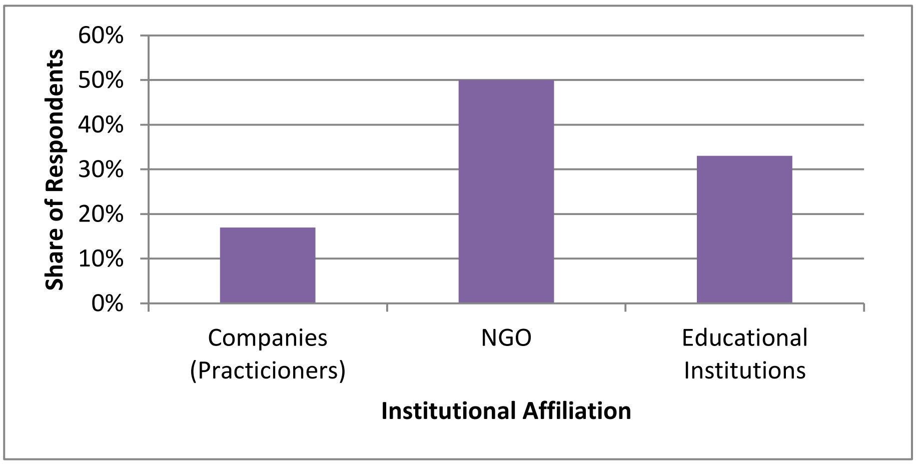


Figure 8.1. Institutional Affiliation Background of Respondents

Figure 8.2 shows the occupational background of experts participating in the study. Among the group, respondents with a job occupation as (forestry) consultants dominated the group and comprised 50%. Those with a job occupation as academicians and (forestry) managers accounted for 33% and 17%, respectively.

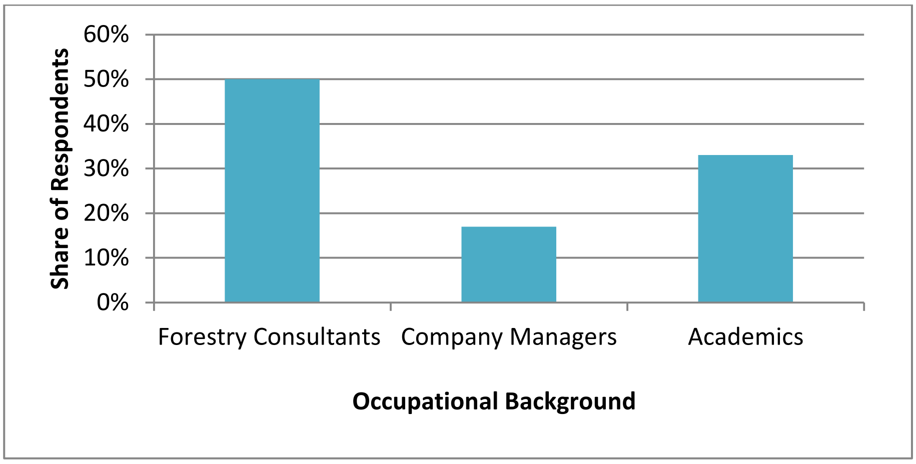


Figure 8.2. Occupational Background of the Respondents

Experts participating in this study have from a variety of educational background. Half of the respondents have doctoral level of education. Meanwhile, respondents with master's and bachelor's degrees were 33% and 17% respectively, see Figure 8.3.

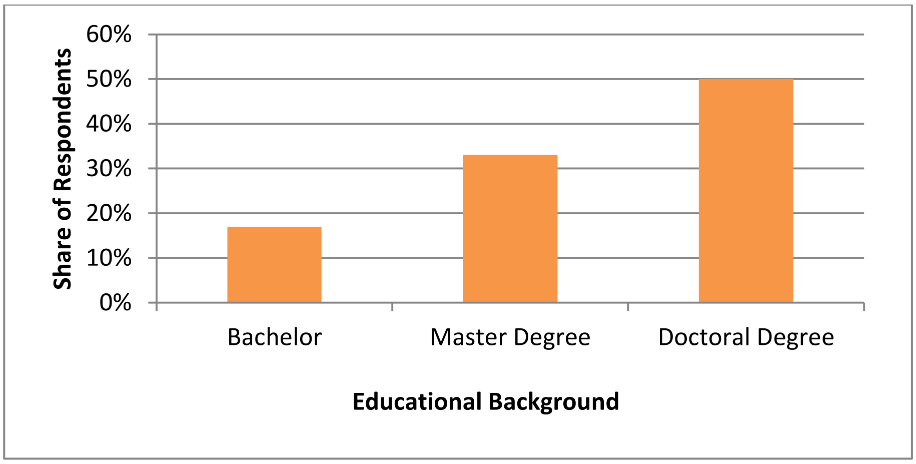


Figure 8.3. Profile of the Respondents based on Educational Background

Figure 8.4. Working Experience of the Respondents

Figure 8.4 displays the work experience background (in years of service) of the respondents. All respondents surprisingly, had a working experience of more than 10 years.

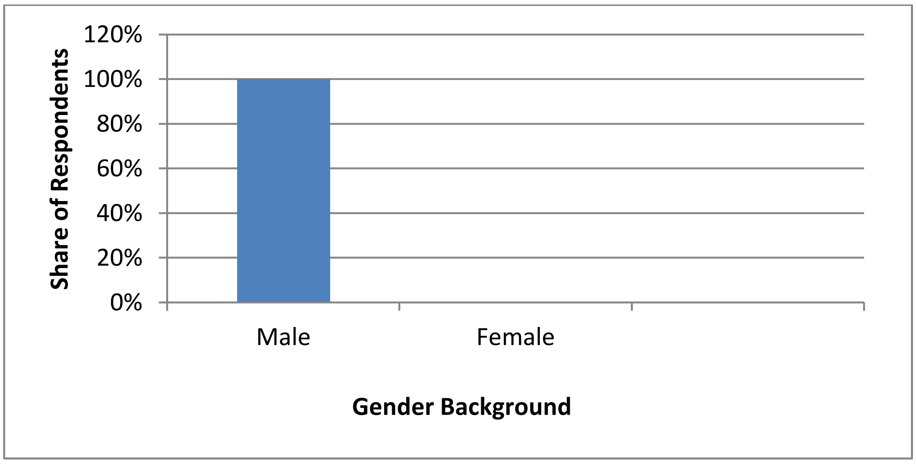


Figure 8.5. Gender Distributions of the Respondents

Figure 8.5 reveals the gender distributions of respondents participating in this study and suggests that male experts are predominant. The figure shows that all experts participating in the study was male.

Confidence weightings

Three levels of confidence associated with each question are high confidence, medium confidence and low confidence. Those categories were standardised by subjectively assigned weights in which high confidence = 3, medium confidence = 2, and low confidence = 1. In the study, the assignment of the weighting scale was simple and arbitrary; while in the original technique this weight was inferred from a focus group discussion (Slevin et al., 1998). The relative weights were then utilised to aggregate individual judgment from the first set of data to produce nominal group opinions.

Expert Group Elicitation

The aforementioned group consisted of experts whose skills and experience are relevant to forest management and/or reduced-impact logging (RIL) technique. The experts received several questions related to the RIL and forest certification (FC). Table 8.4 demonstrates the results and the process of aggregating experts' elicitation with regard to increasing production/logging costs (in percentage terms) due to applying the RIL technique. There is a disagreement among experts over the impact of applying the RIL on the production cost. Four respondents indicated that the RIL would increase the production cost varying from 3% to 36%, compared to conventional logging (CL). Two respondents, however, estimate that logging cost of RIL technique is 8% and 10% less expensive the conventional logging business as usual.

Such diverse judgments among experts are probably due to differences in the current logging practices on which their estimation were based. Furthermore, different biophysical conditions, costs of labour and equipment, other operating inputs, as well as socio-economic and institutional factors contribute to the differences (Enters, Durst, Applegate, Kho, & Man, 2002).

Interestingly, the aggregated experts' elicitation suggests that the RIL technique would increase the production cost by 6.50%. This value is similar to the average value obtained from the arithmetical calculation. This suggests that if experts' opinion have similar weight of confidence, result of the CONFIDE is similar to that simple arithmetical calculation. High confidence of the respondents' judgment also indicates a better knowledge/familiarity to RIL issue.

Table 8.4. Results and aggregation of experts' opinions on the increase in production costs due to applying the RIL technique

Expert	Score/Judgment (Percentage term)	Confidence	Weight of Confidence	Normalised Score
1	-10.00	High	3	-1.67
2	8.00	High	3	1.33
3	36.00	High	3	6.00
4	-8.00	High	3	-1.33
5	3.00	High	3	0.50
6	10.00	High	3	1.67
Sum	39.00		18	6.50
			Average value	6.50

Source: Author calculation

Table 8.5 displays the process of aggregating respondents' opinions on the productivity increase (in term of output) resulting from applying the reduced-impact logging technique (in percentage terms). Because of the relative confidence in providing judgment, the aggregate value of the increase in productivity due to applying the RIL comes to 9.94%. This number is slightly lower than the aggregate value derived by using the simple average technique (10.5%).

Table 8.5. Process of aggregating experts' opinions on the increase in production output (productivity) due to adoption of the RIL technique

Expert	Score/Judgment (Percentage term)	Confidence	Weight of Confidence	Normalised Score
1	15.00	High	3	3.00
2	15.00	High	3	3.00
3	10.00	High	3	2.00
4	10.00	High	3	2.00
5	-7.00	High	3	-1.00
6	20.00	Med	2	2.00
Sum	**63.00**		**17**	**9.94**
			Average value	10.50

Source: Author calculation

Table 8.6 shows the process and result of combining experts' opinions regarding the increase in costs due to the adoption of forest certification. The experts estimate that the adoption of forest certification would raise the cost by 6.35%. The table also reveals that (i) most experts are confident in their judgments and (ii) according to their judgments, the percentage cost increase range from 4% to 18%. However, this judgment has a narrower range compared to that of elicitation of estimated production cost increase due to the reduced-impact logging application (which ranges from -8% to 36%).

With regard to the increase in productivity resulting from applying the forest certification, the experts' aggregate estimate suggests that it would increase the productivity by 7.31% compared to business as usual (as shown by Table 8.7). The table also informs the variety of expressed opinion on the increase of productivity, which range from 0% (no increase on productivity) to 18%, and the experts' confidence.

Table 8.6. Process of aggregating experts' opinions regarding the increase in production costs due to adopting Forest Certification

Expert	Score/Judgment (Percentage term)	Confidence	Weight of Confidence	Normalised Score
1	0.00	High	3	0.00
2	7.00	High	3	1.24
3	3.00	High	3	0.53
4	4.00	High	3	0.71
5	10.00	High	3	1.76
6	18.00	Med	2	2.12
Sum	**42.00**		**17**	**6.35**
			Average value	7.00

Source: Author calculation

Table 8.7. Process of aggregating experts' opinions regarding the increase in production output (productivity) due to adopting Forest Certification

Expert	Score/Judgment (Percentage term)	Confidence	Weight of Confidence	Normalised Score
1	3.00	Low	1	0.23
2	0.00	High	3	0.00
3	10.50	Low	1	0.81
4	5.00	High	3	1.15
5	7.00	Med	2	1.08
6	17.50	High	3	4.04
Sum	**43.00**		**13**	**7.31**
			Average value	7.17

Source: Author calculation

Table 8.8 and Table 8.9 show the processes and results of aggregating experts' judgments on estimating the level of incentive that should be awarded to forest companies for engaging in the adoption of the RIL technique and adopting the forest certification, respectively. Table 8.8 suggests that the financial incentive that should be awarded to logging companies for maintaining the RIL technique was estimated to be US$ 35.08 per hectare per year. Meanwhile, as in Table 8.9, aggregated expert opinion suggested an annual incentive of US$ 466.69 per hectare required by the companies for maintaining the forest certification. Notice that higher variation of expression of confident level (in providing opinion related to provision of incentive) is more obvious in Table 8.8 than those in Table 8.9. Experts seem to have more confidence in judging the level of incentive related to forest certification rather than RIL.

As argued in some literature, certified forest products may receive a premium price. However, some respondents were quite pessimistic about gaining the premium price for the certified forest product and rather considered it as a market barrier. Muhtaman (2004) suggests that market disincentives for the certified forest products occur because of lack of appreciation for a policy of log certification from market countries (such as Korea, China, and Middle Eastern countries) and existing illegal timber traded in these countries. However, a respondent estimated that the certified timber product may receive a price as high as 7% above the market price.

Table 8.8. Process of aggregating experts' opinions regarding the incentives that should be provided to maintain the adoption of the RIL technique

Expert	Score/Judgment (US$/ha)	Confidence	Weight of Confidence	Normalised Score
1	2.00	Med	2	0.33
2	5.00	High	3	1.25
3	30.00	Low	1	2.50
4	250.00	Low	1	20.83
5	40.00	High	3	10.00
6	1.00	Med	2	0.17
Sum	**328.00**		**12**	**35.08**
			Average Value	54.67

Source: Author calculation

Table 8.9. Process of aggregating experts' opinions regarding the incentives that should be provided to maintain forest certification

Expert	Score/Judgment (US$/ha)	Confidence	Weight of Confidence	Normalised Score
1	4.00	Med	2	0.50
2	15.00	High	3	2.81
3	2,000.00	High	3	375.00
4	350.00	High	3	65.63
5	120.00	High	3	22.50
6	2.00	Med	2	0.25
Sum	**2491.00**		**16**	**466.69**
			Average value	415.17

Source: Author calculation

Previously, the processes of aggregating experts' judgment through both a simplified CONFIDE approach and a simple arithmetic method were presented and their results from those approached were compared. Despite being an approximate of the original CONFIDES approach, advantages and disadvantages identified are:

- The method demonstrated in the study may fit a situation in which a decision should be made without a face to face meeting. In this case, opinion can be obtained from each individual and information is subsequently aggregated.

- The process may benefit from the increased knowledge based on individual opinions without the meeting itself. This is due to the involvement of weighting based on level of confidence in the judgment of the respondent . The operating condition, i.e. the anonymity under which the process was carried out might possibly enhance the group results. For example, under this process, individuals with better expertise or more skill but lower authority in a group context may express more confidence in their judgments.
- Value weight of confident judgment involved within the process partially contributes to the aggregate decision value. However, the involvement of weight in this simplified CONFIDE may produce confusing and conflicting results, compared to the results produced from the simple arithmetic. Higher or lower aggregate decision value derived from the CONFIDE technique –compared to the simple arithmetic decision value-- does not suggest a better or worse decision. If all individuals give similar high (or low) confidence values, results are similar to the values obtained from the simple arithmetic, as in the Table 8.4. Furthermore, if 'true answer' of the question is not known or available, it is very difficult to justify whether the aggregate decision of the simplified CONFIDE is improved e.g. through statistical test, as demonstrated in the original work.

In addition, this study was able to confirm and obtain information on reduced-impact logging (RIL)'s cost increase and estimate of incentive level required for rewarding the application of RIL through a survey of experts opinion. The simplified CONFIDE approach was also able to demonstrate to capture the relative difference in confidence between group members which may contribute to the aggregate result of the differing opinions.

8.7 Policy Scenario Formulation for RIL

Policy scenario related to RIL was formulated based on the results of the survey, as follows:

The results of the experts' opinion survey suggests that applying RIL would increase the logging costs by about 7% and this cost is assumed to be incremental and distributed proportionally to all primary and intermediate inputs. The fact that the increased costs to produce a unit output makes the production cost less efficient, seems to be in concurrence with the RIL's prescription to limit tree removal to 8 trees/ha (while it is possible to extract more in East Kalimantan forests). The experts also suggested an incentive of US$ 35/ha/year was required to maintain the RIL application.

Unfortunately, the Berau Forest Carbon Program or BFCP (see section 2.3.2 Chapter 2 on the BFCP) has not yet formulated the type of incentive payment mechanism. The programme is still exploring possible forms of rewards to logging companies, in return for applying reduced-impact logging. The output subsidy was considered to be a performance-based incentive and this approach was applied within the CGE model simulation. A key assumption in this simulation is that the RIL policy applies to all logging companies in the District. Meanwhile, calculation of the output-based subsidy rate was as follows:

The Berau District's total (natural) forest concessions are 782,650 ha. In Indonesia, the selected cutting system uses a 35-year (harvesting) rotation (Gustafsson et al., 2007), so each year the District concession forests to be harvested are 22,361.4 hectares. Therefore, the required compensation equals 22,316.4 x US35/ha = US$ 782,650/year. With an exchange rate of IDR 9,000/US, this approximates IDR 7,043.85 million.

The output subsidy rate equals the compensation divided by the value of the logging sector output which was taken from the 2007 Berau SAM account. This equals

= (7,043.85/ 369,302.43) * 100 = 1.91 % or 2%,

And this rate would be used in the CGE simulation.

8.8 Conclusion

Reduced-impact logging (RIL) has been introduced since 1992 and it has been a long endeavour, particularly in the tropics, to put it into practice. There is also a continuous debate with regards to the consequence of implementing the RIL to logging costs i.e. whether the RIL practice is more expensive than conventional logging. Furthermore, some researchers have shown that the RIL could contribute to emissions reduction efforts under the framework of reducing emissions through deforestation and forest degradation in developing country (REDD+). However to ensure the RIL application, it requires an appropriate type and level of incentive.

Within the context of the Berau District and Indonesia, information on whether the RIL would increase logging cost was obtained through relevant experts' surveyed opinion. The surveyed experts also were required to estimate the level of incentive requires to ensuring that RIL application is maintained. An approximation of CONFIDE based on the original work of Slevin et al. (1986) were employed. Results were subsequently formulated to provide inputs for the Berau computable general equilibrium model run.

Chapter 9 Impact of Implementing Reduced-Impact Logging: Simulation Results and Discussion

This chapter presents and discusses the results of CGE model simulations of baseline and reduced-impact logging (RIL) scenarios in the Berau District East Kalimantan Indonesia. While the former represents “business as usual” or a prediction of the future of the Berau economy if no new policies are implemented, the latter analyses the economic impacts if a non-voluntary policy of reduced-impact logging is applied in the District. Two scenarios were considered:

a. Implementing the RIL only - without providing any incentives / compensation, and
b. Implementing the RIL with a 2% output-subsidy rate on the timber sector. Section 2.2 briefly elucidates these scenarios.

9.1. Simulation Results

9.1.1. Baseline Scenario (Base)

The baseline simulates the development of the Berau economy up until 2025. Because the dataset for the CGE model of the Berau District’s economy is from 2007, and there is no relevant information for modelling purposes available beyond 2010, the CGE has been calibrated to follow the actual growth of the district from 2007 to 2010, and the assumed economic growth from 2011 to 2025. Although the Berau economy is projected up to 2025, which is 18 years of simulation, any policies would be implemented in 2016 when the Berau Forest Carbon Program (BFCP) is scheduled to be fully implemented (Ministry of Forestry Indonesia et al., 2011). That is, any changes only take into account 10 years simulation.

In the base case, Berau GRP growth dropped by 2.44% from 2007 to 2008. After a small increase of 1.5% in 2010, it fell back again by 1.5% in 2011. From 2011 onwards, it is assumed that the Berau economy will continue growing at a steady rate of 7% (see Figure 9.1). Such an assumption was derived from the District’s growth rate from 2006 to 2010; which is higher than the 4.9% of Indonesia’s projected growth from 2010 to 2019 (Abler, 2010). Historically, the Berau economy has been growing at a higher rate that of both East Kalimantan Province and Indonesia (see Figure 2.3 Chapter 2).

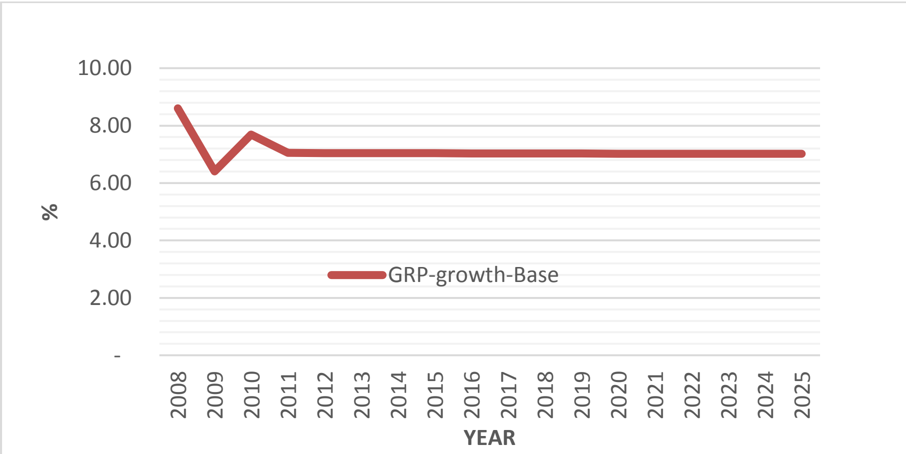


Figure 9.1 Baseline Scenario of Berau District's GRP Growth (2007-2025)

Table 9.1 presents the macroeconomic results of the baseline simulation in the years 2007, 2010, 2015, 2020 and 2025. Note that, in general, all macro indicators (except consumer price index) are assumed to grow at the rate of 7% after 2010. Table 9.1 shows that the expected real GRP – real terms at 2007 prices - of the Berau District in 2010, 2015, 2020 is IDR 5,406,552.84 million, 7,598,078.15 million, 10,670,869.38 million and IDR 14,978,752.95 million, respectively. The GRP of 2015 equals 1.24 times its value of 2007 (see row 1, column 6 of Table 1). The GRP of 2015, 2020, and 2025 is projected to be 1.40 times the level of 2010, 2015, and 2020, respectively (see row 1, column(s) 7-9 of Table 1).

Table 9.1 The Berau District Macro Indicators of the Baseline Scenario

Macrovariable	Value (in IDR Million)					Ratios			
	2007	2010	2015	2020	2025	2010 to 2007	2015 to 2010	2020 to 2015	2025 to 2020
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GRP	4,344,727.53	5,406,552.84	7,598,078.15	10,670,869.38	14,978,752.95	124.44%	140.53%	140.44%	140.37%
Hou. Cons.	733,432.10	910,915.11	1,280,306.66	1,797,965.11	2,523,248.42	124.20%	140.55%	140.43%	140.34%
Gov. cons.	353,089.35	442,753.60	620,984.83	870,963.34	1,221,571.14	125.39%	140.26%	140.26%	140.26%
Investment	1,040,070.79	1,292,339.63	1,816,795.79	2,552,072.86	3,582,747.20	124.25%	140.58%	140.47%	140.39%
Exports	3,027,025.39	3,766,042.78	5,293,081.80	7,434,254.40	10,436,171.52	124.41%	140.55%	140.45%	140.38%
Imports	808,890.10	1,005,498.28	1,413,090.93	1,984,386.33	2,784,985.34	124.31%	140.54%	140.43%	140.34%
CPI	100.00	99.98	99.98	99.99	99.99	99.98%	100.01%	100.00%	100.00%
Gov. Savings	262,257.43	320,066.79	452,003.39	636,814.09	895,557.79	122.04%	141.22%	140.89%	140.63%
Net Export	2,218,135.29	2,760,544.50	3,879,990.87	5,449,868.07	7,651,186.18	124.45%	140.55%	140.46%	140.39%

Source: Model output
Notes:
Figures are in million rupiah, at 2007 prices.
Ratio of an indicator is calculated as the indicator value in last period to the value of the beginning period. For example, Ratio of GRP 2015 to 2010 is calculated as the GRP Value in 2015 to the GRP value in 2010.

In the baseline, government consumption is set at the rate of the Berau economy, while household consumption grows endogenously. The baseline suggests that the ratio of household consumption in 2025 to 2015 is slightly higher than that of government consumption. This seems to fit Berau's historical trend within the period 2005 – 2010 (see rows 2 & 3, cols. 5 & 6 of Table 9.2). In the baseline, ratio of the investment level at 2025 to 2015 is relatively higher than others, which is relevant to the historically higher growth of the District's investment (see row 4, Table 9.2). Exports and imports of the baseline simulation grow at the rate of the district economy. Hence, the ratio of exports in 2025 to 2010 is only marginally that of imports in 2025 to 2010 (Unfortunately, it is rather difficult to obtain conclusive trend for imports and exports from the Berau historical data).

In the baseline simulation, ratios of macro variables to total GRP have been fixed. The ratio of exports to total GRP is the largest (almost 70%), followed by the ratio of investment to GRP (24%). Imports and household consumption ratio to GRP is about 18%, while the government consumption ratio to total GRP is the least (see column 1 of Table 9.3). The trend of the simulation results is expected to fit that of those historical trends. The historical data suggests that the ratios of exports and investments to the District GRP are high accounting for 53% and 41%, respectively. Imports and households share about the same ratio (about 18%); and government consumption contributes the least (see the last column of Table 9.3). Furthermore, one can notice that the above ratios of the baseline in general similar to the corresponding ratios in 2005 and 2006.

Table 9.2 Comparison of the Berau District Macro Indicators between Baseline Simulation (2010 - 2025) and Historical Data (2005 to 2010)

Macroindicator	Value (in IDR Million)				Ratio	
	Baseline Simulation		Historical data		Baseline	Historical
	2015	2025	2005	2010	2025 to 2015	2010 to 2005
	(1)	(2)	(3)	(4)	(5)	(6)
GRP	5406552.838	14978752.95	2,649,725.76	3,690,404.11	277.05%	139.27%
Households	910915.1059	2523248.419	439,521.43	760,552.11	277.00%	173.04%
Government	442753.5992	1221571.141	143,185.51	172,937.45	275.90%	120.78%
Investment	1292339.63	3582747.202	801,462.27	2,066,179.23	277.23%	257.80%
Exports	3766042.779	10436171.52	1,772,206.76	1,509,932.14	277.11%	85.20%
Imports	1005498.276	2784985.341	506,650.21	819,196.82	276.98%	161.69%

Source: Model output
Notes:
Figures are in million rupiah, at 2007 prices.
The ratio of an indicator is calculated as the indicator value in last period to the value of the beginning. For example, Ratio of GRP 2025 to 2015 is calculated as the GRP Value in 2025 to the GRP value in 2015.

Table 9.3 Ratio of the Berau District's Macro Indicators to GRP between Baseline Simulation (2007 - 2025) and Historical Data (2005 to 2010)

Macroindicators	Ratio Macroindicator to GRP							
	Baseline simulation	Historical Data						
	2007 to 2025	2005	2006	2007	2008	2009	2010	Average
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Households	16.88%	16.59%	16.02%	19.43%	18.38%	19.69%	20.61%	18.45%
Government	8.13%	5.40%	4.88%	4.95%	4.30%	4.16%	4.69%	4.73%
Investment	23.94%	30.25%	30.49%	43.58%	40.64%	45.37%	55.99%	41.05%
Exports	69.67%	66.88%	67.28%	48.95%	51.94%	44.92%	40.92%	53.48%
Imports	18.62%	19.12%	18.68%	16.91%	15.26%	14.14%	22.20%	17.72%

Source: Model output and the Berau Statistics Office

Table 9.4 shows the baseline consumption value level of different households at 5-year interval. At the end of the simulation, the households' consumption level is projected to vary between 2.43 and 2.45 times the base years' consumption (see column 9). Agricultural-based households' consumption is expected to grow at a slower rate than non-agricultural households. This is because relative wages of agricultural labour, which are the source of the main income of this household type, decline the most in the baseline.

Table 9.4 The Berau District's Households Consumption Level of the Baseline Scenario

Macrovariable	Values (in IDR Million)					Percentage Change to 2007			
	2007	2010	2015	2020	2025	2010	2015	2020	2025
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Forestry worker - HFW	22,573.59	27,862.58	39,167.44	54,975.72	77,075.27	100.00%	123.43%	173.51%	243.54%
Forestry self-employee - HFSE	17,056.40	20,989.60	29,522.92	41,450.46	58,116.26	100.00%	123.06%	173.09%	243.02%
Agricultural worker - HAW	11,712.12	14,444.56	20,309.99	28,514.34	39,982.85	100.00%	123.33%	173.41%	243.46%
Agricultural self-employee - HASE	159,948.67	198,512.30	278,838.52	391,266.44	548,623.95	100.00%	124.11%	174.33%	244.62%
Non-agricltural worker - HNAW	220,893.67	274,703.37	386,188.41	542,514.86	761,751.83	100.00%	124.36%	174.83%	245.60%
Non-agricltural self employee - HNASE	219,421.48	272,609.24	383,263.50	538,372.54	755,775.34	100.00%	124.24%	174.67%	245.36%
Others - HOTH	81,826.16	101,783.56	143,040.32	200,866.87	281,923.86	100.00%	124.39%	174.81%	245.48%

Source: Model output

Notes:

Figure are in million rupiah (where applicable).
The percentage shows the ratio between the level of a particular year to the value in 2007.

In the baseline, activities' outputs of the manufacturing and service group grow relatively faster than agricultural activities. During the simulation, the land factor for the agriculture is relatively constant causing the agricultural group's output to grow relatively more slowly than the demand for agricultural products; as opposed to the case in the manufacturing and service sectors (see Appendix 9.1). This causes output prices of agricultural products, in real terms, to increase, or to rise at a higher rate than those of the manufacturing and service commodities, during each of the simulation years.

9.1.2. Applying the RIL Policy Scenario

As part of the BFCP program, the Berau District plans to implement the reduced-impact logging (RIL) technique within its logging sector commencing in 2016

(Ministry of Forestry Indonesia et al., 2011). According to experts consulted as part of this research, implementing RIL in the timber sector would increase logging costs by 7% [see last section of Chapter 8]. As previously mentioned in this Chapter's introduction, two different simulations related to the RIL implementation would be tested. Those are:

(i) Implementing RIL only – no incentive (**RIL0 Scenario**)

This policy simulates implementing the non-voluntary (compulsory) RIL without any financial incentives to the logging sector;

(ii) Implementing RIL with a 2% output-based subsidy rate (**RIL2 Scenario**)

Berau Forest Carbon Program or BFCP, a strategic plan guiding an emissions reduction program in the Berau District, has not indicated a mechanism to distribute incentives to parties/stakeholders engaged in emission reduction activities, including an instrument to compensate forest concessions for their engagement in the RIL practice. Despite this fact, a CGE simulation which involves providing an incentive to the forest concessions was applied. The simulation assumes the RIL0 Scenario plus a 2% output-based subsidy in the logging sector.

Macroeconomic results

Table 9.5 reports macroeconomic variable condition in 2025 under baseline, RIL0 and RIL2 scenarios (cols. 2 to 4), value difference in 2025 from baseline (cols. 5 & 6), and percentage change from the baseline (cols. 8 & 9). Columns 7 & 10 inform the differences of macro-indicators in 2025 under the RIL0 and RIL2 policies in values and percentage terms. Meanwhile, Figure 9.2 shows the deviation of real GRP from the baseline in terms of percentage change, as effects of RIL0 and RIL2 scenarios. Since the scenarios start in 2015, no changes occur between 2007 and 2014. As a result, this period is excluded in this and any subsequent graphs appearing in this document.

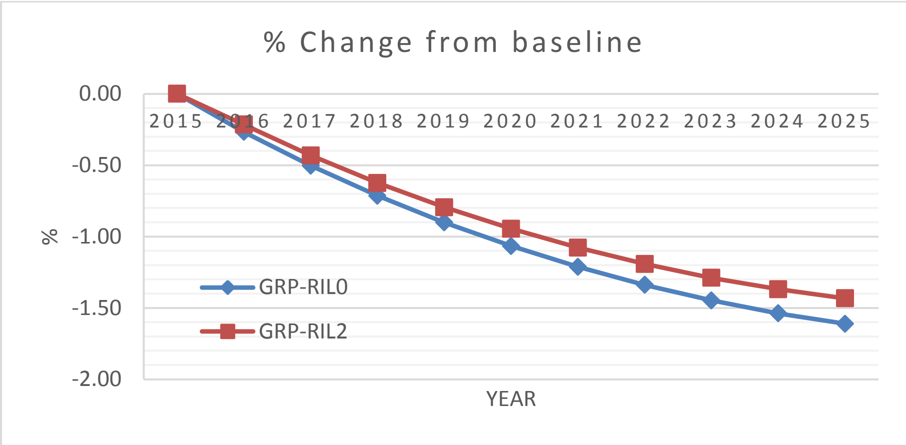


Figure 9.2 Impact of RIL Policies on the District's Real GRP

In 2025, the RIL0 policy brings about a loss in the Berau's GRP of IDR 241.42 billion which is equal to 1.61% of the district's real GRP in 2025 of the baseline condition (see row 1, cols. 5 & 8 of Table 9.5). Under the RIL0 scenario, the losses of the district's real household consumption, investment, and exports in 2025 are IDR 29.10 billion, IDR 65.39 billion, and IDR 178.79 billion, respectively. Import value in 2025 also falls by IDR 31.85 billion from the base condition, and this is equal to 1.14% of the import value in 2025. There are also declines in net exports of the Berau District under the RIL0 and RIL2 scenarios.

The RIL2 policy marginally improves conditions that would otherwise occur under the RIL0 policy. In 2025, there is a very small GRP gain of 0.18% or equal to IDR 26.70 billion (see row 1, cols. 7 & 10 of Table 9.5) from the GRP under the RIL0 policy. There are also positive gains in other macroeconomic variables as an effect of the log output-based subsidy. These improvements are shown by positive signs in cols. 7 and 10 of Table 9.5. Note that under both policies, government consumption is assumed to grow at a fixed rate relative to the Berau economy and the government saving is residual. Consequently, in any policies, the government consumption is not affected but the saving is impacted.

Table 9.5 Changes in Macro Economic Indicators under different RIL Policies

Macrovariable	Value in 2025			Value difference from Base in 2025		Difference	% Change from Base in 2025		Difference
	Base	RIL0	RIL2	RIL0	RIL2	(6) - (5)	RIL0	RIL2	(9) - (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
GRP	14,978,752.95	14,737,335.86	14764034.73	-241,417.08	-214,718.22	26,698.86	-1.61%	-1.43%	0.18%
Hou. Cons.	2,523,248.42	2,494,151.21	2498013.143	-29,097.21	-25,235.28	3,861.93	-1.15%	-1.00%	0.15%
Gov. cons.	1,221,571.14	1,221,571.14	1221571.141	0.00	0.00	-	0.00%	0.00%	0.00%
Investment	3,582,747.20	3,517,358.56	3534049.316	-65,388.64	-48,697.89	16,690.76	-1.83%	-1.36%	0.47%
Exports	10,436,171.52	10,257,385.89	10273721.92	-178,785.63	-162,449.61	16,336.03	-1.71%	-1.56%	0.16%
Imports	2,784,985.34	2,753,130.94	2763320.791	-31,854.40	-21,664.55	10,189.85	-1.14%	-0.78%	0.37%
CPI	1.00	0.97	0.97	-0.03	-0.03	0.00	-2.98%	-2.77%	0.22%
Gov. Savings	895,557.79	840,206.21	855261.0764	-55,351.58	-40,296.71	15,054.87	-6.18%	-4.50%	1.68%
Net Export	7,651,186.18	7,504,254.95	7510401.127	-146,931.23	-140,785.06	6,146.18	-1.92%	-1.84%	0.08%

Source: Model output

Note:

Figure are in million rupiah, real terms of 2007 prices (where applicable).

Impact on households

Changes in household consumption may indicate a change economic welfare for households (Coleman, 2008). The change in value of household consumption also reflects changes in income level. Figures 9.3, 9.4 and 9.5 show the annual percentage change in each household type's consumption from baseline. In Figure 9.5, under the RIL0 policy, consumption of agricultural (non-forestry) worker households (HAW) declines from more than 2% in 2016 to nearly 10% in 2025. Under the RIL2, the household consumption is down by more than 1.5% in 2016 to about 9% in 2025.

Table 9.6 shows households' consumption in 2025 under different RIL policies. The RIL0 Policy brings about considerable loss in agriculture-based household consumption, with forestry households the most negatively affected (see Figures 9.3 and 9.4). Under the RIL0, consumption value losses in 2025 of forestry worker households – HFW, forestry self-employee households – HFSE, agriculture worker households – HAW and agriculture self-employee households – HASE are IDR 7.83 billion, IDR 5.28 billion, IDR 3.87 million and IDR 23.04 billion respectively. These are equivalent to 10.16%, 9.09%, 9.67% and 4.20% of their corresponding consumption values in 2025 under the baseline (see cols. 5 and 8 of Table 9.6). The impact is greater in worker type agricultural households like HFW and HAW than in the self-employee agricultural households (HFSE and HASE) because the relative price of agricultural paid-labour (LAP), a major contributor of the income in the HFW (56%) and HAW (34%) households, falls the most (see Figure 23 and Table 9).

On the other hand, non-agricultural-based households (HNAW and HNSE) experience a positive impact on their real consumption (Figure 9.5). Under the RIL0 Scenario, the gains in 2025 are IDR 10.62 billion and IDR 3.1 billion for the respective HNAW and HNASE. These are comparable to about 1.35% and 0.41% above their baseline consumption values in 2025. The improvement in the household group is due to an increase in the relative price of LNAP, a major source of income for the group (57.5%% for the HNAW and 53% for the HNASE). In addition, another household type (HOTH) consumption in 2025 also fall for about IDR 2.45 billion or 0.87% of its consumption of the baseline in 2025.

The RIL2 Scenario causes the potential loss of consumption value in agricultural-based households to be reduced compared to what would happen in the RIL0 Scenario. Under this scenario, consumption values in 2025 for the respective HFW, HFSE, HAW, and HASE's consumptions declines by IDR 7.46 billion, IDR 4.96 billion, IDR 3.68 billion, and IDR 21.85 billion, which are equal to 9.68%, 8.54%, 9.20%, and -3.98% their consumption levels in 2025 under the base case (see cols. 6 & 9 of Table 9.6). Furthermore, the improvement in the household consumption values under the RIL2 scenario is shown by the positive sign in columns 7 and 10 of Table 9.6.

Table 9.6 Changes in Households' Consumption

Household	Value in 2025			Value difference from Base in 2025		Difference	% Change from Base in 2025		Difference
	Base	RIL0	RIL2	RIL0	RIL2	(6) - (5)	RIL0	RIL2	(9) - (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Forestry worker - HFW	77,075.27	69,244.49	69,612.44	-7,830.78	-7,462.83	367.95	-10.16%	-9.68%	0.48%
Forestry self-employee - HFSE	58,116.26	52,833.90	53,152.85	-5,282.37	-4,963.41	318.95	-9.09%	-8.54%	0.55%
Agricultural worker - HAW	39,982.85	36,116.68	36,304.07	-3,866.17	-3,678.78	187.39	-9.67%	-9.20%	0.47%
Agricultural self-employee - HASE	548,623.95	525,575.34	526,774.96	-23,048.60	-21,848.99	1,199.62	-4.20%	-3.98%	0.22%
Non-agricltural worker - HNAW	761,751.83	772,001.30	772,376.82	10,249.47	10,624.99	375.52	1.35%	1.39%	0.05%
Non-agricltural self employee - HNASE	755,775.34	758,891.12	759,944.35	3,115.78	4,169.01	1,053.22	0.41%	0.55%	0.14%
Others - HOTH	281,923.86	279,469.08	279,861.84	-2,454.78	-2,062.02	392.77	-0.87%	-0.73%	0.14%

Source: Model output
Note:
Figures are in million rupiah (where applicable).

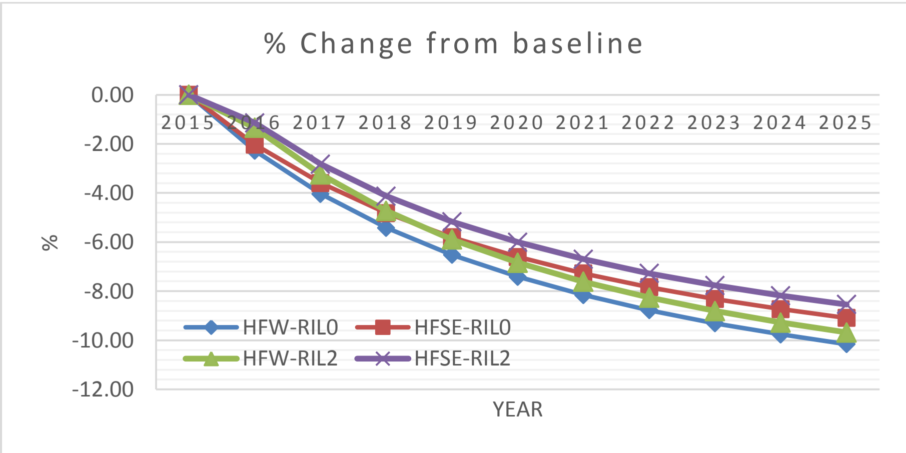


Figure 9.3 Impact of RIL Policies on Forestry Worker (HFW) and Forestry Self-Employee (HFSE) Households' Consumptions

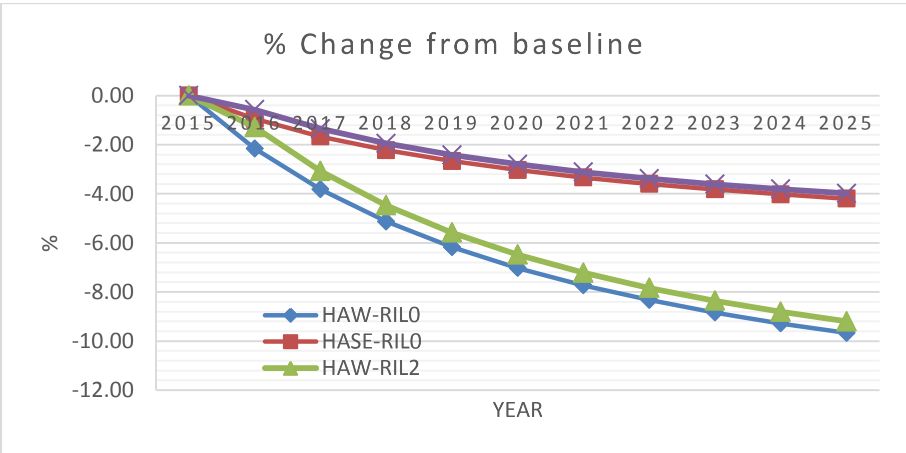


Figure 9.4 Impact of RIL Policies on Agricultural Worker (HAW) and Agricultural Self-Employee (HASE) Households' Consumptions

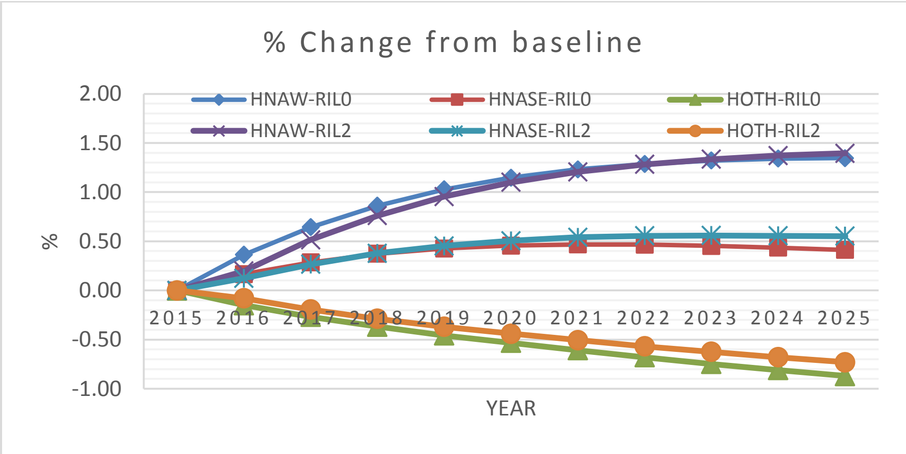


Figure 9.5 Impact of RIL Policies on Non-Agricultural Worker (HNAW), Non-Agricultural Self-Employee (HNASE), and Other (HOTH) Households' Consumptions

Impact on Activity Levels

Both RIL0 and RIL2 policies create significant negative impacts on logging (TIMB) and non-timber products (OFOP)'s output. The RIL0 policy causes the TIMB output to decline by almost 8% below baseline in 2015 to about 40% in 2025 (see Figure 9.6). The falls of TIMB and OFOP output values in 2025 are IDR 497.19 billion and IDR 3.23 billion from their values under the baseline, respectively (see relevant row, col. 5 of Appendix 9.2). Providing incentive, as in the RIL2 Scenario, decreases the level of impact (e.g. the impact of RIL0 on TIMB is depicted by the grey line in Figure 9.6). Under the RIL2 scenario, the output values of TIMB and OFOP in 2025 are IDR 473.03 billion and IDR 2.43 billion; suggesting a gain of IDR 24.16 billion in TIMB and IDR 0.79 billion in OFOP from what would happen in the RIL0 scenario (see relevant rows in cols. 6 & 7 of Appendix 9.2).

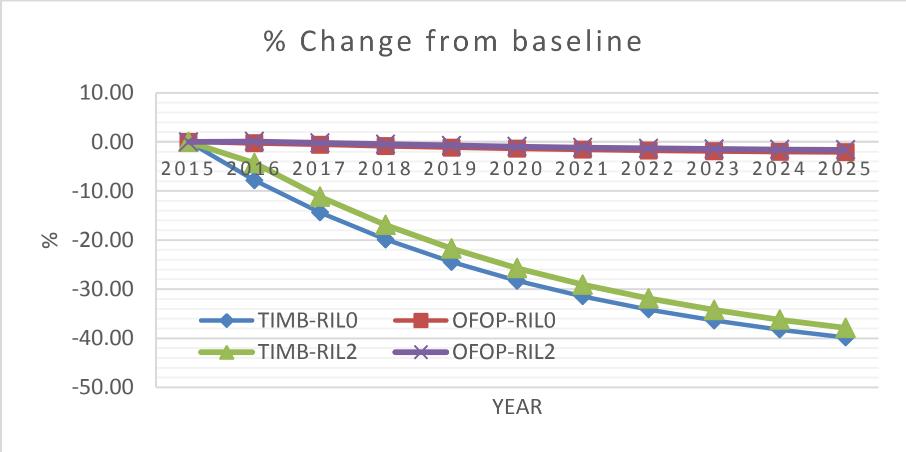


Figure 9.6 Impact of RIL Policies on Timber (TIMB), and Non-Timber Forest Products (OFOP)'s Activity Levels

There seems to be a positive correlation between the sectors of TIMB and OFOP. As the TIMB is negatively affected by the RIL-related policy, so does the OFOP. The output subsidy given to the TIMB also positively affected the OFOP activity's output. Rist et al. (2011) point out that as forest are becoming more accessible, there is also more opportunity for the extraction of non-timber products. In reverse, less production of timber may reduce the production of non-timber products.

The impact of the RIL0 policy on output level is positive and relatively large in oil palm (OILP), and other estate crops (OESC), (see Figure 9.7), and in fisheries (FISH). Meanwhile, the impact is small in food crops (FCRO), see Appendix 9.2. In 2025, there are gains in OILP, OESC, FISH, and FCRO sectors of IDR 174.85 billion, IDR 25.93 billion, IDR 130.17 billion, and IDR 27.96 billion, respectively from the baseline. For the respective sectors, these equal 53.40%, 23.01%, and 5.75%, of their baseline output values in 2025 (column 8 of Appendix 9.2). For the OILP, OESC, and FCRO, the RIL2 policy causes their output to decline (see relevant rows, cols. 6, 7, 9 & 10 of Appendix 9.2).

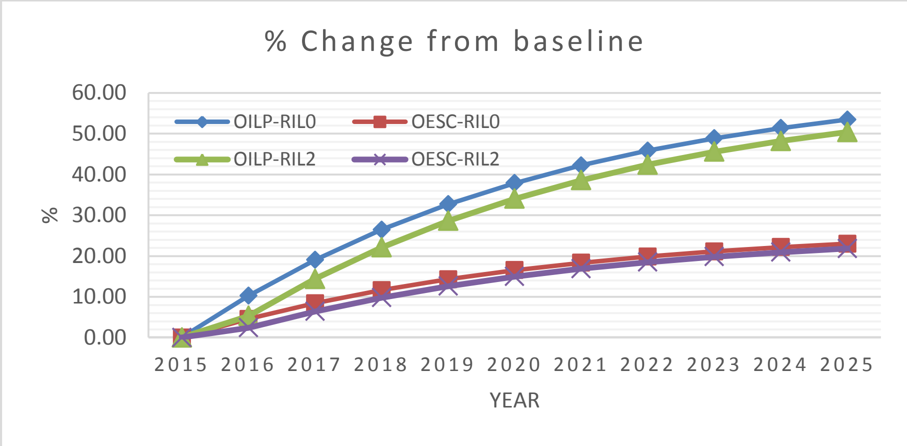


Figure 9.7 Impact of RIL Policies on Oil Palm (OILP), Other Estate Crops (OESC) and Food Crops (FCRO)'s Activity Levels

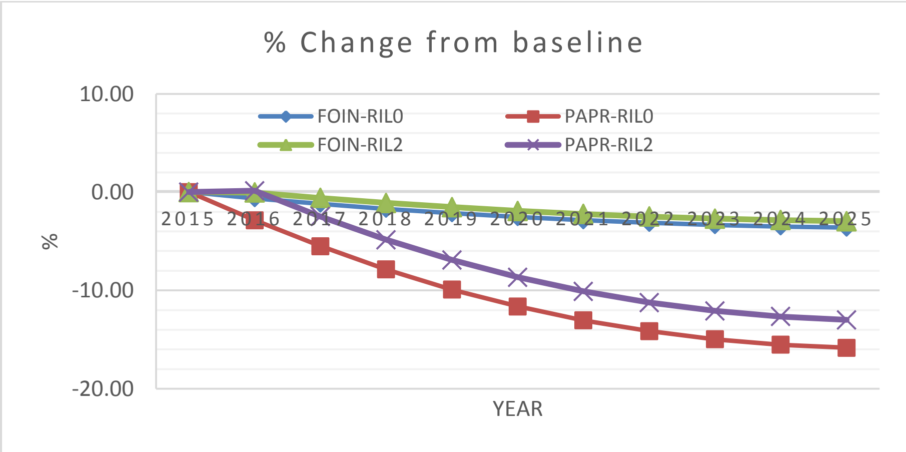


Figure 9.8. Impact of RIL Policies on the Activity Levels of the Timber-based Industry (FOIN) and Pulp, Paper and Printing (PAPR)

Within the manufacturing group, the effect of RIL policies is negative for both forestry-based industry (FOIN) and pulp & paper (PAPR). Under the RIL0 policy, the FOIN and PAPR's outputs in 2025 are smaller by about 4% and 16% compared with their outputs under the baseline. The impact is greater in the PAPR than in the FOIN since the PAPR consumes 48% of the domestic TIMB's output (while the FOIN's consumption of the TIMB commodities is 1%). Under the RIL2 Scenario, the FOIN and PAPR outputs in 2025 are about 38% and 1.6% smaller than their baseline values in 2025, suggesting an improvement of 2% in the FOIN and 0.5% in the PAPR (see relevant rows in cols. 9 & 10 of Appendix 9.2). The effect of the subsidy is depicted by delays in the effect of the RIL0 policy (see in Figure 9.9). Due to higher absorption of the TIMB commodity, positive effect of the output subsidy in the TIMB's sector generates more obvious improvement in the PAPR activity rather than in the FOIN.

Within the manufacturing group, the impact of the RIL-related policies is moderate and positive in food-processing (FBIN) and (fertiliser and other chemical) FERC outputs. The increase of these sectors' output is stimulated by the increase of FCRO, OILP, OESC and FISH outputs. Meanwhile, the policies give small and negative effects in COAL and OILR.

Overall, the impact of the RIL scenarios on the output of sectors that fall under the service group is negative except for the Transportation (TRAN). However, the fall in output level of electricity and water (ELWT), construction (CONS), trades (TRAD), communication (COMM), finance (FINA), corporate service (SERV), and public service (PUBO) are relatively small (see 5 last rows, cols. 8 & 9 of Appendix 9.2).

Impact on regional Composite Commodity Supply (Absorption)

In a CGE model, composite commodity supply, which is defined as a commodity mix of locally produced goods marketed domestically and imported commodities, equals domestic absorption, and also the sum of the commodity mix that is used for intermediate demand (production activities), and final demand (household and government consumption and investment).

Within the agricultural group, the impact of RIL policies is large and negative for timber (TIMB) and small for (non-timber products) OFOP and (livestock) LIVS. The effect of the RIL policy on the regional supply/demand of the TIMB composite commodity is less than the impact on the TIMB's output because domestic consumers shift towards imported TIMB commodity which has lower price relative to the TIMB's domestic price (i.e. there is an increase of the TIMB commodity's import). A positive effect occurs in the rest of the agricultural sectors with a large positive effect in OILP.

Under the RIL0 Scenario, the losses in 2025 of the TIMB and OFOP are IDR 124.86 billion and IDR 3.5 billion; and these equals 14.10%, and 2.15% of their values in 2025 under the baseline. In 2025, there is a large gain in OILP's composite supply of IDR 41.90 billion or 45.48% of its baseline value in 2025. A considerable gain is found in FISH, while small gains occur in FCRO and OESC (see first 7 rows of Appendix 9.3). Meanwhile, Figure 9.9 shows the percentage change in aggregate supply from baseline for the TIMB and OFOP and Figure 9.10 demonstrates a big impact on the OILP's aggregate supplies.

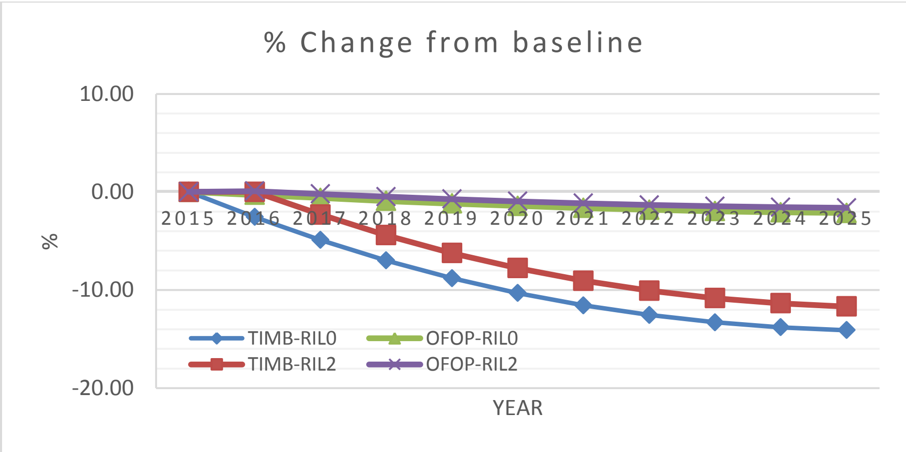


Figure 9.9 Impact of RIL Policies on TIMB and OFOP's Composite Supply Levels

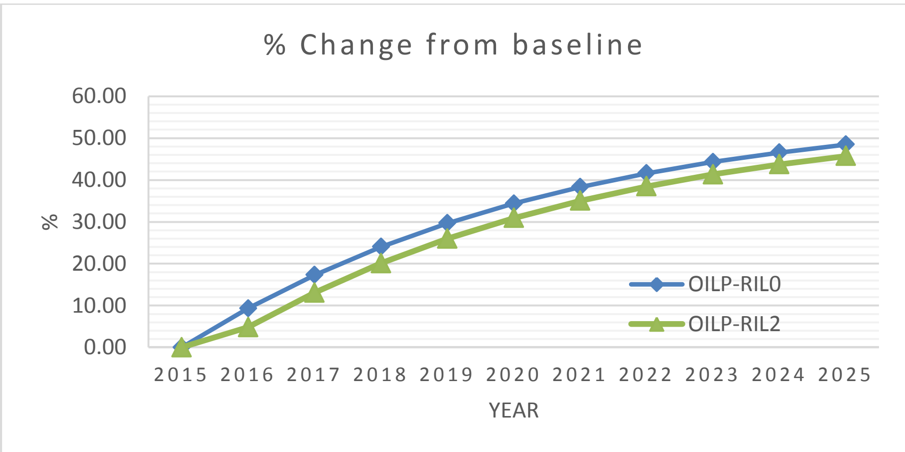


Figure 9.10 Impact of RIL Policies on OILP's Composite Supply Level

Within the manufacturing group, the RIL0 policy negatively affects the aggregate supply of all manufacture except for the COAL and FERC. Since a larger share of the manufacturing commodities are consumed by the district's household (see Appendix 7.4), the decline in households consumption (as a negative impact of the RIL policy on the households) causes the manufacture's production to fall. In 2025, the largest fall occurs in PAPR, losing IDR 206.62 billion or about 12% of its value in 2025 under the baseline. The losses in composite commodity of FBIN, TEXTL, FOIN, and OILR are between 2% to 3%. Meanwhile, COAL and FERC experience increases of around 4% (see relevant sectors in Appendix 9.3). Figure 9.11 shows the annual percentage change from the baseline in FOIN and PAPR composite commodity value levels.

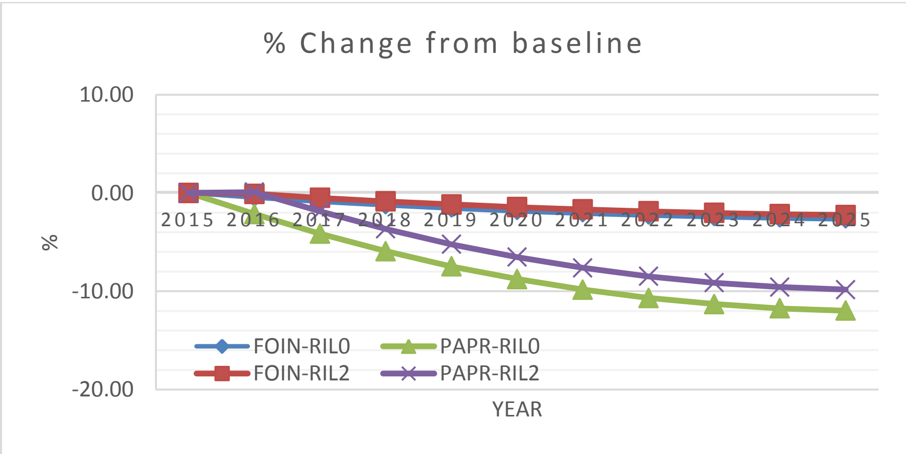


Figure 9.11 Impact of RIL Policies on FOIN and PAPR's Composite Supply Levels

RIL-related scenarios bring about negative effects for all composite supplies that fall under the service group except in transportation (TRAN). In 2025, the largest change from baseline occurs in corporate service composite supply (SERV) which is about 5%. Meanwhile, changes in other composite commodities are below 3%, see cols. 8 & 9 of Appendix 9.3).

Impact on composite commodity prices

Appendix 9.7 presents percentage change of composite commodity prices under different scenario in 2025 from their prices in 2015 (as shown in cols. 2, 3, and 4), and differences between those changes. In general, relative prices of agricultural composite commodity prices decrease; while those of commodities under manufacturing and service groups increase. This is due to the relative increase in the agricultural activities, and relative falls in manufacturing and service production.

Figure 9.12 demonstrates percentage change in the composite price of TIMB from baseline as a positive impact of the RIL related scenario. In 2016, the price will be 2.5% above baseline in the RIL0 Policy, and goes up to 14% in 2025. Under the RIL2 Policy, the relative price will be only 0.5% above baseline in 2015, and goes up to 12% above baseline. Furthermore, under the RIL0, relative price of the TIMB's composite commodity in 2025 is 114.16% its price in 2015. This change is about 14% above the TIMB's price in 2025 under the baseline. Meanwhile, the changes in relative prices of other agricultural commodities are smaller than those prices under the baseline (see cols. 3 & 5 Appendix 9.7, under Agricultural group).

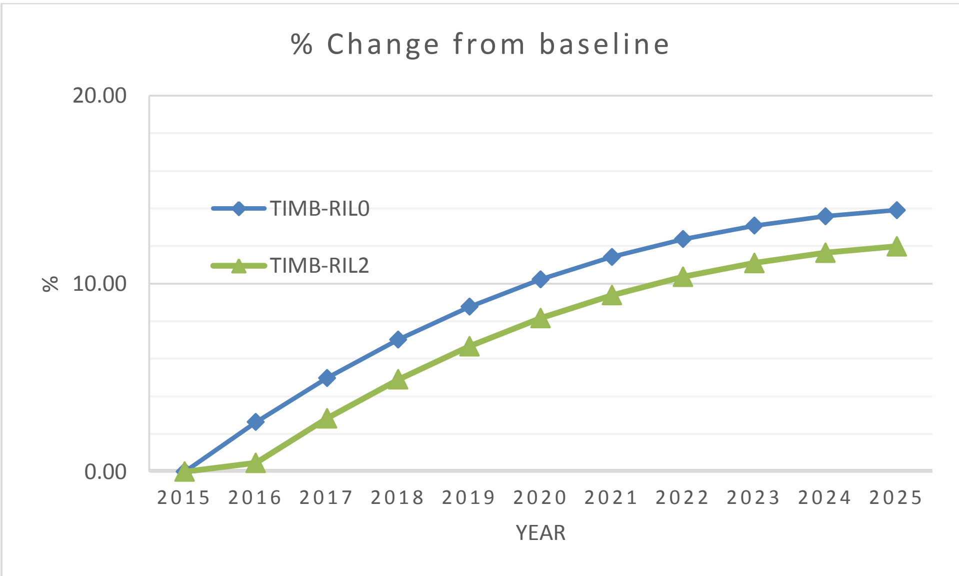


Figure 9.12 Impacts of RIL Policies on TIMB and OFOP's Composite Commodities Prices

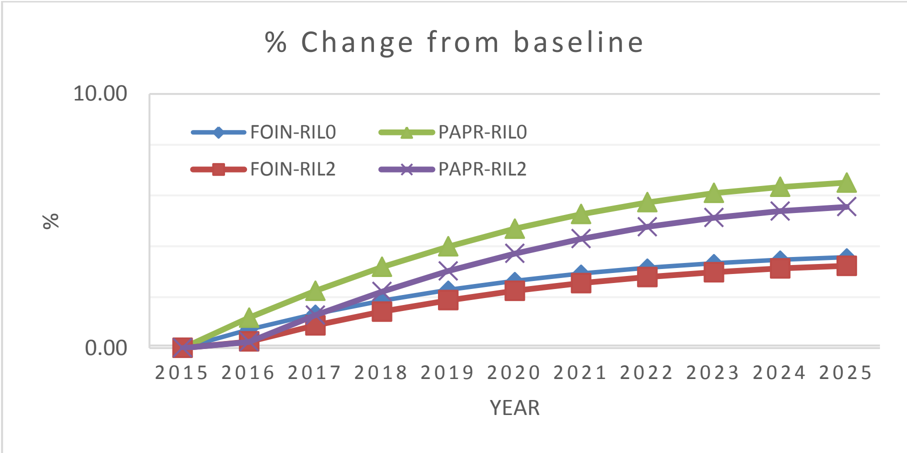


Figure 9.13. Impact of RIL Policies on FOIN and PAPR's Composite Commodities Prices

Within the manufacturing group, RIL policies affect positively the composite price of all commodities except in COAL (due to the decline in almost all composite commodity supplies). Under the RIL0 Scenario, all commodity composite prices (excluding of COAL) in 2025 range between 101% and 106% their relative prices in 2015. The largest growth occurs in the FOIN and PAPR composite commodity prices (see relevant rows cols. 3 & 5 of Appendix 9.7).

The effect of RIL-related policies on the relative composite prices of commodities that fall under the Service Group is positive except for TRAD and TRAN commodity prices. However, the change in relative price of the commodity of the service group is generally smaller than the changes in composite commodity of the agriculture and manufacture groups.

Impact on exports

The impact of RIL-related policies is negative only for TIMB exports (see Figure 9.16), and positive for other agricultural-based activities (see Appendix 9.6). Under the RIL0 scenario, there is a loss in the TIMB export in 2025 of 427.78 billion or 70.50% below the baseline. On the other hand, there are gains in other agricultural exports; especially in OILP exports worth IDR 145.82 billion and in FCRO, OESC, and FISH (see cols. 5 & 8 of Appendix 9.6). The RIL2 policy reduces the degree of loss in the TIMB and the gain in other agriculture exports that would occur in the case of the RIL0 policy. For example, TIMB exports in 2025 improves by 1.5% from what otherwise occur under the RIL0 policy. Meanwhile, the annual percentage change of exports in the TIMB, OILP and OESC commodities are presented in Figure 9.14 and Figure 9.15.

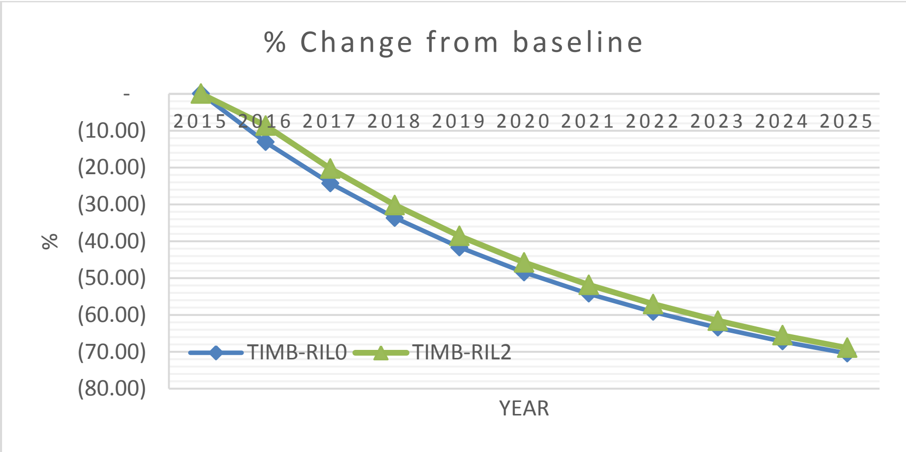


Figure 9.14. Impact of RIL Policies on TIMB's Export Level

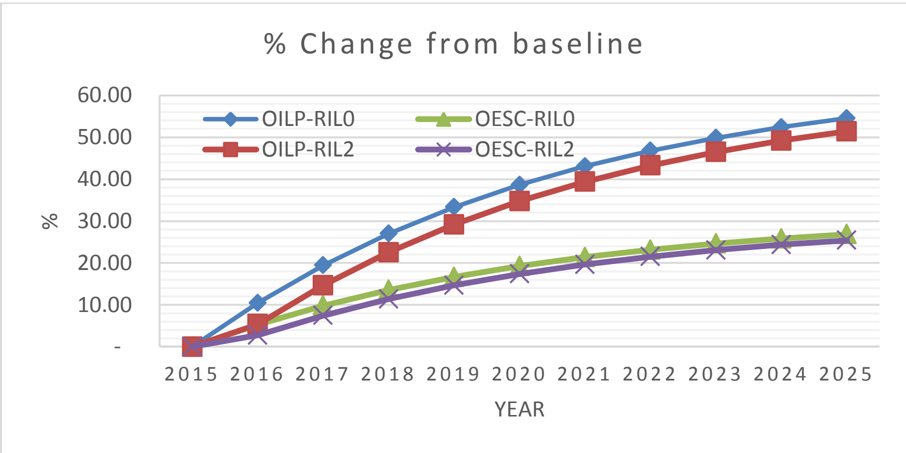


Figure 9.15. Impact of RIL Policies on OILP and OESC's Export Levels

Within the manufacturing group, the impact of RIL-related policies on exports is negatively medium on FOIN and significant on PAPR (see Figure 9.16). The policy impact is positive and substantial in COAL, FBIN and FERC; and minor on TEXT and OILR. Under the RIL0 policy, the losses in 2025 from FOIN and PAPR exports are IDR 0.73 million and IDR 479.10 billion or 5.72% and 17.62% below their respective value in 2025 under the baseline. Meanwhile, the gains from the COAL, FBIN, and FERC exports in 2025 are IDR 492.80 billion, IDR 19.10 million, and IDR 23.20 million, respectively (see Appendix 9.3). Under the RIL2 Scenario, the losses in the FOIN and PAPR in 2025 are decreased by 1.11% and 3.16%, respectively (see relevant rows, column 10 of Appendix 9.6).

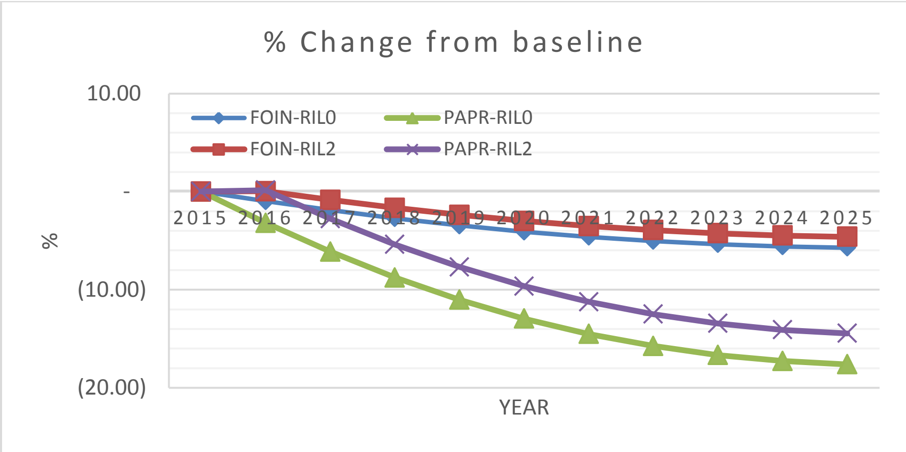


Figure 9.16. Impact of RIL Policies on COAL and PAPR's Export Levels

Lastly, the RIL-related policies' effect on the export of activities that fall under service group is generally negative except for TRAN (which is positive). The changes of exports values in 2025 from their baseline are relatively small and below 2.5% (see last 8 rows cols. 8 & 9, Appendix 9.6).

Impact on imports

Overall, the impact of RIL-related policies on imports of the Berau District's commodities is negative except for TIMB, COAL, and FERC commodities (see cols. 8 & 9 of Appendix 9.5). Under the RIL0 policy, change of the TIMB's import value in 2025 is IDR 21.28 billion, or more than 46% of its value under the baseline. Figure 10.1 shows the percentage change of the TIMB import from the baseline under the RIL scenarios. Meanwhile, the decline in other agricultural commodities' import ranges from 2% to 6% below their base value levels in 2025. Under the RIL2 Policy, a small increase occurs in TIMB imports worth IDR 1.1 million. The RIL2 policy would also increase the import values of the agriculture-based commodities although to a relatively lesser degree (except for OILP where there are no imports) compared to what would be attained in the RIL0 scenario (see Agricultural group, cols. 7 & 10 of Appendix 9.5).

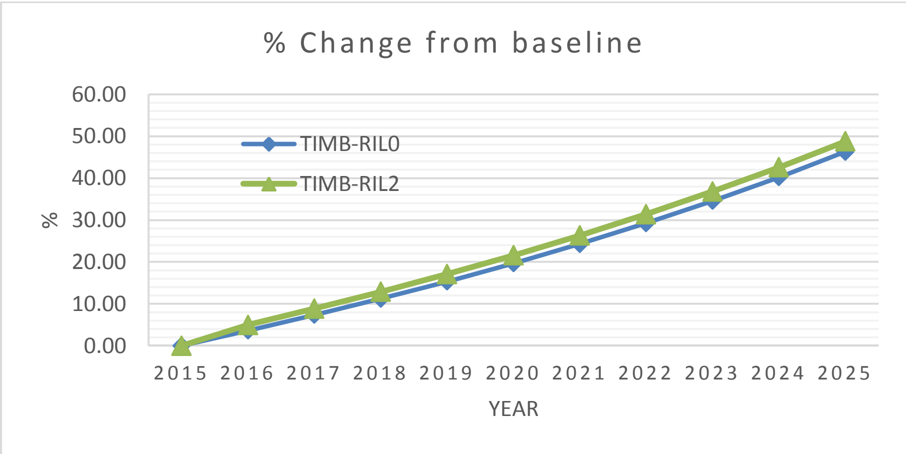


Figure 9.17. Impact of RIL Policies on TIMB's Import Level

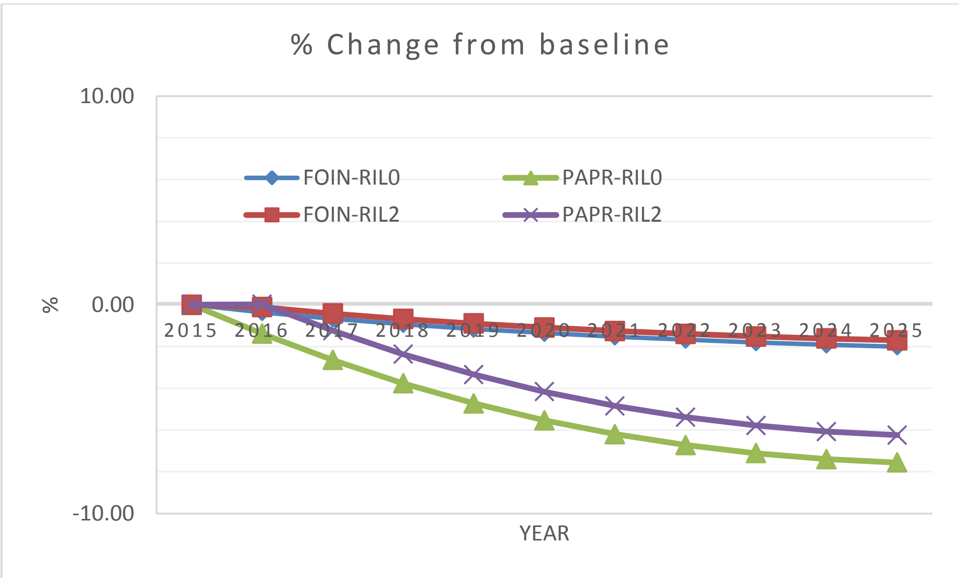


Figure 9.18. Impact of RIL Policies on FOIN and PAPR's Import Levels

The effect of RIL scenarios on import levels of commodities that fall under group of the manufacturing is positive only in COAL and FERC import activities. Annual percentage changes in import levels of FOIN and PAPR commodities as impacts of these policies are depicted in Figure 9.18. The FOIN import goes down about 1%

below baseline in 2016 and down to 2% in 2025; and the PAPR import level is about 2% below baseline in 2015 to 7.5% in 2025.Under the RIL0 policy, value changes from the baseline of the FOIN and PAPR imports in 2025 are IDR 1.60 billion IDR 0.57 billion, respectively. These are 2% and about 8% their respective baseline import values in 2025. Meanwhile, percentage changes of other manufacturing imports in 2025 under this policy are between 1.5% and 3.5% (see relevant rows cols. 8 of Appendix 9.5)

Lastly, the impact of RIL-related policy in import of the Service group is negative; which is relatively significant in TRAD and SERV, minor in ELWT and small for the rest of the group. In 2025, under the RIL0 Policy, TRAD and SERV suffer drop by more than 8% and about 6% below their baseline condition. While the decline is more than 3% in ELWT, the decrease is less than 2% for the rest of the group (see column 8, Service Group, Appendix 9.5).

Impact on factors of income prices

The effect of the RIL scenarios on the relative prices of factors of income of the Berau's household is negative for agricultural-based labour (see Figure 9.20) and land return (Figure 9.21). Under the RIL0 policy, relative prices of paid agricultural labour - LAP, non-paid agricultural labour – LANP, non-paid non-agricultural labour - LNANP and land return prices in 2025 grow 90.67%, 96.17%, 96.54% and 216.59% from their prices in 2015. The decrease of TIMB and OFOP sectors' output due to RIL policy forces these unused factors to shift to other agricultural sectors. In order to be re-employed, the factors are ready to accept the relatively low price due to competition with other factors of production (e.g. other type of labours). Note that all factors should be employed since the CGE model adopts a full-factors employment.

Meanwhile, the relative price of LNAP and capital are 104.28% and 100.07% their relative prices in 2015 (see column 3 of Table 9.7). The RIL2 scenario improves the relative prices of LAP, LNAP, LNANP and land returns that were negatively affected by the RIL0 policy while reducing the positive effects in the LNAP and capital price (see column 6 of Table 9.7).

Table 9.7. Changes in Relative Prices of Income Factors

Factors	Change from 2015			Difference		
	Base	RIL0	RIL2	RIL0-Base	RIL0-Base	RIL2-RIL0
(1)	(2)	(3)	(4)	(5)	(6)	(7)
LAP	99.91%	90.67%	90.97%	-9.24%	-8.94%	0.30%
LANP	99.92%	96.17%	96.24%	-3.75%	-3.68%	0.07%
LNAP	100.34%	104.28%	104.11%	3.94%	3.77%	-0.17%
LNANP	100.03%	96.54%	97.25%	-3.49%	-2.78%	0.70%
Cap	99.50%	100.07%	99.94%	0.57%	0.44%	-0.13%
Land	246.35%	216.59%	217.61%	-29.76%	-28.74%	1.02%

Source: Model output

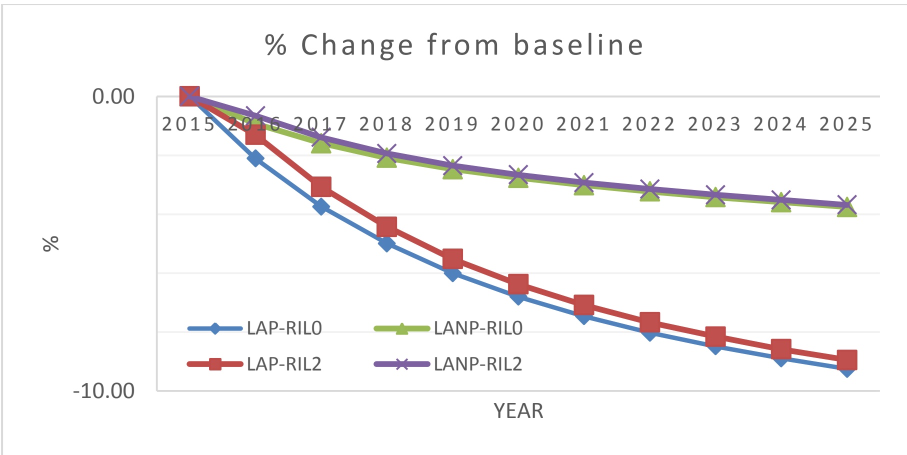


Figure 9.19 Impact of RIL Policies on Agricultural Labour (LAP & LANP) Prices

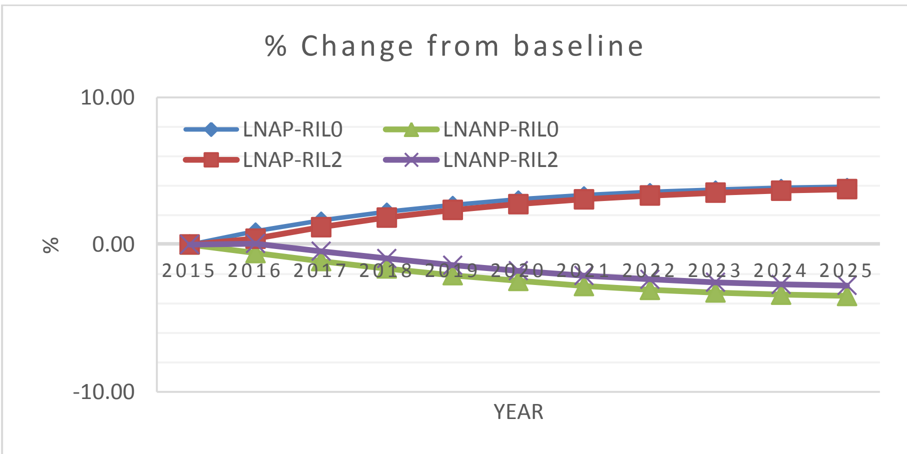


Figure 9.20 Impact of RIL Policies on Non-Agricultural Labour (LNAP & LNANP) Prices

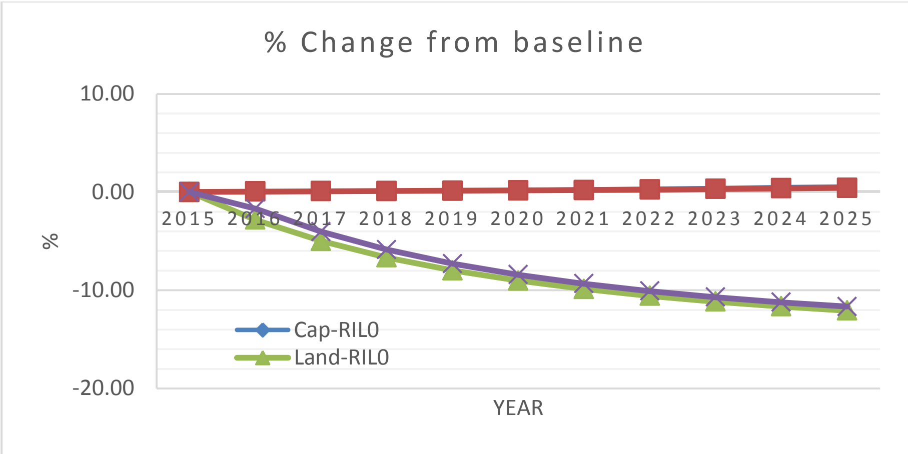
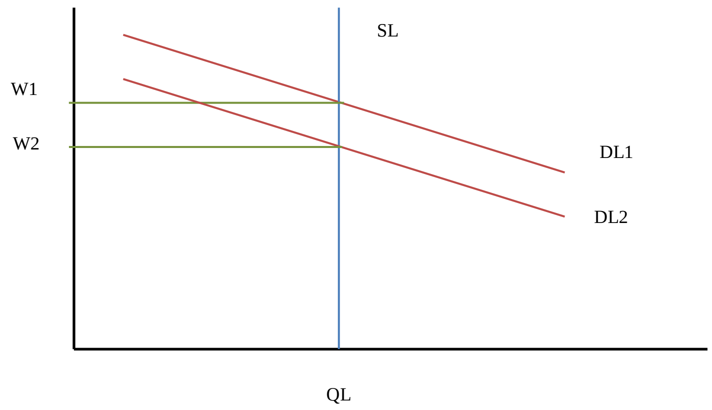


Figure 9.21 Impact of RIL Policies on Capital and Land Return Prices

Impact of fixed labour supply assumption

The Berau CGE model employs an assumption that labour supply is fixed. This implies that employment is assumed to be full within the economy and labour market clearing mechanism is achieved through change in wages if there is a policy to be implemented and furthermore leads to distributional effects. The assumption is usually suitable for a short-medium period CGE modelling where labour is assumed to find it difficult to move out of a region to find a new job. Consider the Figure 9.25 below; the amount of labour supply in the district is QL, and the labour supply curve is the vertical line, SL. In this initial condition, demand for labour is represented by the curve DL1 and wage rate is W1. The policy of implementing reduced-impact logging caused the Berau economy to decline and less amount of labour is required i.e. for the contracting domestic production. This is shown by a downshift from labour demand curve DL1 to DL2. Because the total amount of labour within the District should be fixed, i.e. along the vertical line of SL, wage rate falls down from W1 to W2. This explains the decline in the relative price of agricultural (paid) labour as a result of implementing RIL.



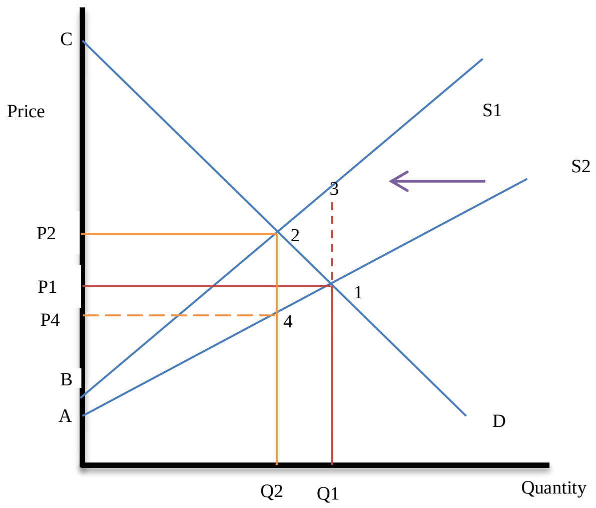
Source: modified from Burfisher (2011)

Figure 9.22 Effect of an assumed fixed endowment on wages

Explaining the RIL's impact on log output

It was demonstrated that reduced-impact logging policy, which was modelled as an incremental increase in logging costs, reduced the logging output value level. Implementing the RIL policy without any incentive would produce a total loss (over 10 years) in the TIMB sector of IDR 2.756.81 billion, equal to 434% of output value in 2015. A partial equilibrium diagram in Figure 9.22 explains the impact of the increased cost on the logging output.

In Figure 9.22, S1 and D represent the supply and demand curve, respectively. In initial equilibrium condition of point 1, output level is Q1 with the output price of P1. Suppose, due to the RIL Policy, production costs increase and in order to produce the same level of Q1, more inputs are required, as indicated by point 3 where the same quantity of outputs can be produced at higher cost. Subject to consumer preference, higher prices of output stimulate a fall in consumer demand, as shown by a movement from point 1 to point 2. At this new equilibrium condition, less output (Q2) is produced, at a higher price (P2) than the original price of P1.



Source: modified from Burfisher (2010)

Figure 9.23 Impact of RIL Policies on Timber Quantity and its Output Price

As the logging output decreases, some factors of production that were previously used within the logging activity are now unemployed. Since factors of production, particularly agricultural labour, such as agricultural paid labour - LAP and agricultural non-paid labour – LNAP, are assumed to be relatively mobile and their shift to other agricultural sectors would stimulate production increases in these other agricultural activities. Because real wages, that is the ratio of the labour wage used for production to the relative price of (oil palm) output is the highest among the agricultural group, more labour moves to this sector and motivates most of the oil palm production upsurge.

Under the RIL0 Scenario, the Berau District suffers from losses that can be explained using Figure 9.22. In the Figure, the triangle area A-1-C represents an economic surplus which is a sum of producer surplus (represented by A-1-P1) and consumer surplus (an area of P1-1-C) at an initial equilibrium. The RIL0 policy reduces the area of consumer surplus into P2-2-C, losing the area of P1-1-2-P2. Meanwhile, the producer loses an area of P1-1-4-P4, from its original surplus.

Therefore, the total loss is represented by an area P4-4-1-2-P2; which is the difference between the economic surpluses prior and post policy implementation.

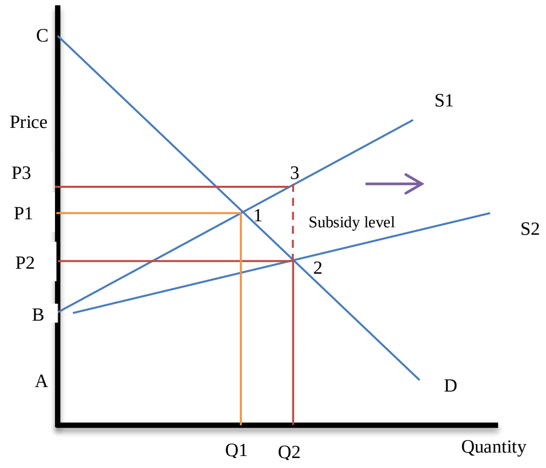


Figure 9.24 Impact of Output Subsidy on Timber Quantity and its Output Price

Result simulation suggests that output subsidy of 2% improves the timber output by 36.71% in 10 years' simulation from what otherwise would occur under the RIL0 Policy. The first round effect of this policy can be shown by a partial equilibrium diagram in Figure 9.23. Consider Point 1 as an equilibrium point where the RIL0 Policy is implemented with the quantity output Q1 and price P1. To help timber producers dealing with an increase of production cost due to the RIL requirement, output-based subsidy from international party is provided. This will shift supply function from S1 to S2 which is a new supply function with subsidy. After the subsidy, a new equilibrium is established at Point 2, where higher quantity is produced at Q2, at lower prices of P2. Because of the subsidy, P2 is the price level that consumer pay (less than the original price), and P3 is actually the price that the producer receive, which is higher than the price without subsidy. Since the vertical distance between Point 2 to point 3 is the subsidy per unit output, the area of P2-2-3-P3 represents the total amount of subsidy that should be paid.

After the subsidy, the consumer surplus was enhanced by the area of P1-1-2-P2, as addition to the original consumer surplus of P1-1-C. Producer surplus also expands by an area of P1-1-3-P3. The total amount of subsidy is greater by a triangle area of 1-2-3 than the sum of the consumer and producer surplus. This denotes welfare /deadweight loss, which is fortunately not borne by the District since the subsidy is from an international party.

Will Berau be a net importer of timber?

Applying reduced-impact logging (RIL) causes timber production in Berau to significantly decline; which leads to a considerable decrease in the timber exports. The relative domestic price of the timber commodity rises as a consequence of reduced production; and producers shift to purchase the commodity from outside the District. This leads a significant increase in the Berau's import of timber. This situation raises a question whether the District will become a net of importer of timber.

Figure 9.24 show the comparison between value levels of the Berau District's export and import of timber commodity from 2015 to 2025, under baseline (a) and RIL0 (b) scenarios. Figure 9.24 (a) and (b) inform that, in 2015, the initial value level of timber export and import under the baseline and the RIL0 are the same. In 2015, the value of export and import are IDR 309.17 billion and IDR 23.30 billion, respectively; forming a net export of IDR 285.87 billion. Under the baseline scenario, the timber export and import values in 2025 are IDR 607.02 billion and IDR 45.95 billion, respectively; resulting in a net timber export of IDR 651.07 billion. Under the baseline, the timber net export in 2025 has been more than double the value in 2015.

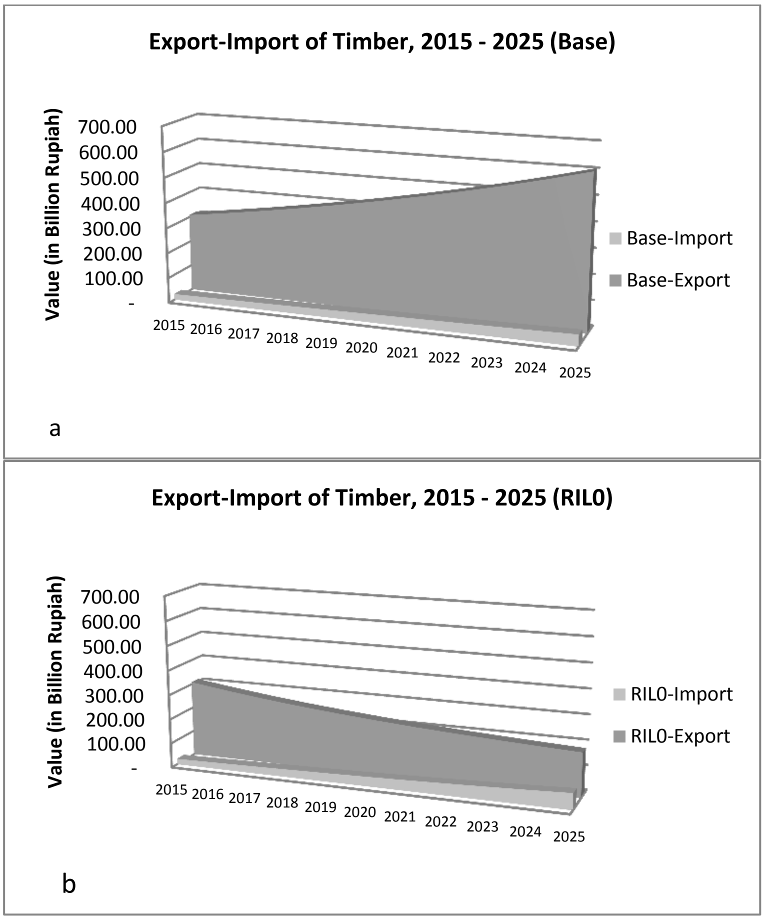


Figure 9.25 Value levels of timber export and import in 2015-2025 under baseline and RIL0 scenarios

Under the RIL0 policy, the 2025's timber export and import values are IDR 179.24 billion and IDR 67.23 billion, respectively (Figure 9.24 (b)). The timber export been shrunk by 60% and the timber import has grown about 3 times, from their values in 2015. As a result, the net export value of timber in 2025, under the RIL0 policy, is IDR 112.01 billion. Despite the shrinkage in net export, the model predicts that Berau will still be net exporter of timber.

Considering the treatment of (log) timber-output subsidy

The Berau Forest Carbon Programme (BFCP) is currently exploring what type and level of subsidy should be provided, and the mechanism of incentive distribution to relevant stakeholders that contribute to emissions reduction efforts. With regard to forest concession holders, Hovani (2012)[54] states that the BFCP considers, but is not limited to, technical assistance e.g. provide financing costs of obtaining certification and direct payment for RIL-performance. For the latter, it is not clear how the payment will be distributed. Therefore, at the stage, an output-based subsidy is considered a performance-based type of incentive relevant to the implementation of RIL.

According to simulation results (under the RIL2 scenario), providing 2% log (timber) subsidy output improves the Berau economy by 0.18 percentage points from the condition under the RIL0 policy. It is also suggested that the incentive improves the timber output value in 2025 by a small proportion (about 2%), from what otherwise would happen under the RIL0. Implementing reduced-impact logging without incentive stimulates a distributional effect where agricultural households (particularly worker household type) are worse off, and non-agricultural households are better off. When the incentive is applied, there are marginal improvements for the agricultural households, and unfortunately, for the non-agricultural household as well.

The aforementioned results may indicate that (i) level of incentive that was estimated by experts was insufficient e.g. since it may only cover cost of logging and did not consider wider aspect of forest management costs; and therefore more funding is required to address the economic effects of the RIL policy, and (ii) setting the incentive as log (timber) output-based subsidy is less appropriate. Further work should be done to investigate the type of subsidy relevant to compensating the RIL implementation and the incentive level to sufficiently minimise the socio-economic impacts of the emissions reduction efforts.

Concerning potential (carbon) leakage

Carbon leakage is defined as the increase in CO2 emissions outside the countries taking domestic mitigation action divided by the reduction in the emissions of these countries (IPCC, 2007). Carbon leakage occurs through an economic process,

[54] Advisor at TNC in Indonesia, email communication

although it may be caused by other anthropogenic and biophysical processes (Wunder, 2008). Aukland et al. (2003) distinguish the leakage based on drivers into (i) primary leakage, and (ii) secondary leakages, see Table 9.8. The former is caused by REDD agents i.e. through activity shifting and outsourcing, and the latter is due to market effects and alternative livelihood activity. Furthermore, the authors note that the leakage is more common in project-based level emissions reduction activity.

As it was previously explained that implementing reduced-impact logging caused the log production to decline and there is a shift in factors of production (notably labour) to other agricultural sectors and stimulate further these activities' production, particularly in oil-palm plantation. There must be an increase of other factors used of for the other agricultural production e.g. land and this may lead to conversion of forest land for the agricultural activities. The shift in demand for land is a typical dominating leakage force for REDD project (Wunder, 2012) and may become source the primary leakage.

There might also be a potential of displacement of emissions outside the Berau District. The decline of timber output induces the relative price of the commodity to rise. This, in turn, causes the consumers to shift their purchase to imported log from outside Berau. A growing demand of the imported timber may subsequently lead an increase in tree removal (degradation) to supply the increased demand. The market mechanisms related to timber supply and demand in the model may be drivers of secondary leakage, as suggested by Aukland et al. (2003).

It is not clear, however, if that implementing RIL would cause the Berau District a net emitter. The simulation results rather indicate that there may be potential of displacement of emissions as a result of the RIL application in the logging sector. This suggests that the RIL policy should be carefully implemented, especially if scope the programme is at the sub national level where such displacement can occur.

Table 9.8. Type of leakage associated with baseline drivers related to RIL application

Project activity	Baseline driver to be neutralised	Type of leakage	Causes of leakage
Alternative technologies of reduced-impact logging	Conventional logging	Primary - activity shifting, e.g. if technologies are imposed on baseline agents, and loggers move elsewhere Secondary – market effects, if the technologies lead to changes in the volume of forest outputs	E.g. intensification of extraction rates elsewhere, by baseline agents, because of failures in the project. E.g. intensification of extraction rates elsewhere, by other actors, in response to reduction in supply

Source: modified from Aukland et al. (2003)

Concerning technology unchanged in CGE model

Prior to concluding this chapter, it is important to note that a CGE model, as in the case of Berau District CGE analysis, assumes that within the timeframe analysis the technologies, represented by input-output coefficient within the SAM data, do not change. This may represent a short to medium period of analysis. In reality, as prescribed by some researchers, implementing RIL may lead to a more sustainable flow of production within a longer term. This can be caused by less destruction of existing stands and seedling, more selective cutting, and most importantly less tree removal per hectare. The current CGE model of the district did not capture such condition, mostly due to a relatively short period of analysis. Within a longer time framework, a model with changing in technology may be preferred.

9.2. Conclusion

The Chapter has presented and discussed results of CGE simulation related to the implementation policy of reduced-impact logging (RIL) on the Berau Economy. Three scenarios were considered i.e. baseline scenario, implementing the RIL without incentive, and implementing RIL with incentive. Impact of these scenarios on the Berau economy was described and demonstrated in the context of micro-economic indicators, composite commodity supply, domestic supply, trade (export and import), and relative prices of commodities, labour, wage and capital. In addition, an issue of potential leakage as a result of implementing the policy is briefly discussed.

Chapter 10 Sensitivity Analysis and Scenario Variations with regard to RIL Policy

Subsequent to Chapter 9 on reduced-impact logging policy simulation, this chapter reports on the results of a sensitivity analysis of the Berau CGE model relative to particular model parameters. The sensitivity analysis was intended to check on the degree of robustness of the simulation results as suggested by Harrison et al. (1993) and (Hosoe, 2010), as presented in Section 11.1; Subsequent section of 11.2 presents a range of simulation results from a series of what-if scenarios related to variation of costs and subsidy levels.

10.1 Sensitivity Analysis in a CGE

Computable general equilibrium (CGE) analysis mainly employs calibration methods rather than econometric methods. Although, the calibration method allows estimation of the model using one period of data, the method is often criticised due to its inability to objectively test the robustness of the parameter estimates and therefore the simulation results. A sensitivity analysis is usually utilised to check the robustness of simulation results by varying parameters that may significantly affect general equilibrium results. The sensitivity analysis is carried out for two purposes: (i) to test the robustness of the simulation results with respect to the assumed value of certain key parameters, and (ii) to provide ‘a kind of confidence interval’ of the simulation results (Hosoe, et al. 2010).

Furthermore, any conclusions drawn from numerical equilibrium models (both partial and general equilibrium) are usually subject to criticism on the basis that the conclusions depend critically on the following three estimated or imposed features of the model: (1) the equilibrium structure imposed on the model, (2) the functional forms employed to reflect tastes and technology, and (3) the elasticity and share parameters (Harrison et al., 1993). However, Hosoe et al. (2010) point out that carrying out a sensitivity analysis on all parameter values would be unrealistic and one should focus on those parameters that are most relevant to the objective of the CGE analysis.

In light to the above, sensitivity analysis carried out in this study was limited in the following ways:

- The RIL0 policy scenario was used in the sensitivity analysis test,
- Because policy scenario applied is closely related to the supply side of agriculture (i.e. timber) activities; and it is assumed that the elasticity of substitution (CES) parameters of primary inputs is critical. As a result, the focus of the sensitivity analysis would be paid on the elasticity of substitution (CES) parameters of primary inputs in the agricultural activities.
- A usual sensitivity analysis involves a selected parameter's prior distribution that is derived from econometric studies related to employed current points estimate (Harrison et al., 1993). Owing to limitations of information in this study, the sensitivity analysis was conducted by employing an *a priori* assumption that the CES of primary inputs in the agriculture group has 20% of higher and lower bound. Accordingly, there are three CES parameters of the agriculture activities' primary inputs: original CES, high CES, and low CES, as seen in Table 11.1.

Table 10.1 Constant Elasticity Parameters (CES) between Primary Factors in Agricultural Activities used for Sensitivity Analysis

Sectors	CES Values		
	Original	Low	High
FCRO	0.75	0.60	0.90
OILP	0.75	0.60	0.90
OESC	0.75	0.60	0.90
LIVS	0.75	0.60	0.90
TIMB	0.75	0.60	0.90
OFOP	0.75	0.60	0.90
FISH	0.75	0.60	0.90

Source: Original CES from Robinson et al. (1997)

- The following steps were used to carry out a sensitivity analysis in this chapter:
    - Define criteria of robustness (see the set criteria of robustness below which was adopted from Hosoe, 2010).

- Run a baseline simulation using each CES values (Hence, there are three baseline simulations).
- Conduct a RIL0 simulation using each CES values.
- Compute, compare and analyses differences between results of a RIL0 simulation and its baseline of the same CES values (e.g. results of baseline and a RIL0 simulations using Low CES).

Following Hosoe et al. (2010, p.138), the robustness of simulation results would be evaluated against two set criteria as follows:

Criterion 1: whether the signs of sectoral output changes are unchanged in all cases (base CES, high CES, and low CES).

Criterion 2: whether the ordering of the output changes among sectors is maintained in all cases.

Sensitivity analysis results

Sensitivity analysis results of RIL0 policy simulation on macro variables of the Berau District are presented in Table 10.2. Three baseline simulations under three CES (original, high, and low CES) were conducted and the differences between the resulted Berau District's macro variable values are very small. For example, gross regional products of the District in 2015 are IDR 7.598.08 billion (under original CES), IDR 7,598.71 billion (under high CES), and IDR 7,597.21 billion (under low CES).

The RIL0 Policy, when simulated under the three cases of CES, gave a consistent results that the Berau economy would experience a loss of 1.6% from the baseline GRP in 2025 (see first row, cols. 10, 11, & 12 of Table 10.2). Under the RIL0 Scenario, total losses in household consumption in 2025 would be slightly over 1% (for all CES variation, see first row 2, cols. 10, 11, & 12 of Table 10.2). Table 10.2 generally indicates that the impacts of the RIL0 Scenario are negative for all macro indicators when simulated under all cases of CES; (see cols. 7 - 12). This suggests that the simulation results are robust with respect to Criterion 1. Furthermore, the small differences between total percentage changes from the baseline under the three selected parameter values suggest that the results are quite insensitive to change in CES values, particularly within the range of +/- 20%.

Table 10.2 Sensitivity Analysis of RIL0 Policy’s Impact on Berau’s Macro Variables

Macrovariable	Value in 2025 (Baseline)			Value in 2025 (Under RIL0)			Value Change from Baseline (in 2025)			Value Change from Baseline (in 2025)		
	Original CES	HIGH CES	LOW CES	Original CES	HIGH CES	LOW CES	ORI CES	HIGH CES	LOW CES	ORI CES	HIGH CES	LOW CES
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
GRP	14,978,752.95	14,982,247.63	14,972,594.89	14,737,335.86	14,741,794.64	14,730,722.93	-241,417.08	-240,452.99	-241,871.96	-1.61%	-1.60%	-1.62%
Hou. Cons.	2,523,248.42	2,525,350.50	2,519,253.67	2,494,151.21	2,498,265.26	2,487,942.81	-29,097.21	-27,085.24	-31,310.86	-1.15%	-1.07%	-1.24%
Gov. cons.	1,221,571.14	1,221,571.14	1,221,571.14	1,221,571.14	1,221,571.14	1,221,571.14	0.00	0.00	0.00	0.00%	0.00%	0.00%
Investment	3,582,747.20	3,584,233.49	3,580,043.49	3,517,358.56	3,519,454.53	3,514,414.73	-65,388.64	-64,778.96	-65,628.76	-1.83%	-1.81%	-1.83%
Exports	10,436,171.52	10,437,703.49	10,433,646.04	10,257,385.89	10,257,830.87	10,256,487.49	-178,785.63	-179,872.61	-177,158.55	-1.71%	-1.72%	-1.70%
Imports	2,784,985.34	2,786,610.99	2,781,919.45	2,753,130.94	2,755,327.16	2,749,693.26	-31,854.40	-31,283.83	-32,226.20	-1.14%	-1.12%	-1.16%
CPI	1.00	1.00	1.00	0.97	0.97	0.97	-0.03	-0.03	-0.03	-2.98%	-2.97%	-2.99%
Gov. Savings	895,557.79	896,630.87	893,595.43	840,206.21	841,376.26	838,507.05	-55,351.58	-55,254.60	-55,088.37	-6.18%	-6.16%	-6.16%

Note: values are in IDR million (where applicable)

Source: Model output

Looking now at whether the results is robust with respect to Criterion 2, under the three cases of CES values, ordering of the relative sizes of macro output changes is maintained. Government saving suffers from the highest changes (loss) in all cases. Exports and investment experiences a total negative impact of around 2%, while the negative impact on imports consumption is the least.

Impact on sectors' output values

Sensitivity test results are shown in Appendix 10.1. Columns 1 to 3 of the Appendix contain the baseline values of sectoral output in 2025 under three different CES parameter values. In all cases of CES variation, the baseline simulation reveals that there are only slight differences in a particular activity’s output value in 2025 under original, high, and low CES. For example, the output value of TIMB under original CES, high CES, and low CES in 2025, are IDR 1,248.01 billion, IDR 1,249.54 billion, and IDR 1,244.99 billion, respectively. The different between the values are below 0.4%.

The results of sensitivity analysis indicate that the simulation results of the RIL0 scenario are robust with respect to Criterion 1. That is, sectors that experienced negative (or positive) effects in the original CES parameter would also be negatively (or positively) impacted in both high and low CES. For example, in all cases, sectors of TIMB, OFOP, FOIN, and PAPR are negatively affected. On the other hand, sectors that are positively impacted in original CES, would also maintain their positive impacts when they are simulated under both high and low CES, such as OILP and FERC (see positive and negative signs in cols. 7 to 12). The table confirms that all sectors are able to maintain the direction of the changes under the three CES values.

With regard to Criterion 2, results simulation also demonstrates consistencies with regard to the ordering of relative sizes of total changes in output values as an effect of RIL0 policy. The table shows (see cols. 7 to 9 of Appendix 10.1) that, in three cases of CES, the highest positive effect is in OILP (around 53%); followed by OESC (around 23%) and FISH (around 19%). Again, under all cases of CES, the negative and most significant change is in the TIMB sector which is the focus of the policy. Subsequently, this is followed by PAPR and FOIN sectors which they are affected by around 16% and 4%, respectively (see relevant rows, cols. 7 to 9 of Appendix 9.11).

10.2 Variation of RIL policy scenarios

Section 8.6 of Chapter 8 suggests that applying reduced-impact logging technique would increase an incremental production costs by 7% and 2% of timber output-based subsidy would be needed to compensate for the increase. Those figures, however, reflect a compromised estimate from various experts' opinions. Further simulations were conducted to show the range of impacts under the different levels of both cost increases and subsidy rates.

10.2.1 Varying the increase in costs

Table 8.4 of Chapter 8 provides the range of logging cost increases due to applying RIL as suggested by surveyed experts. Other scenarios modelled were an increase in logging costs of 3% due to implementation of RIL, anda situation where the RIL is considered cheaper than conventional logging, as argued by some experts. This was accommodated by carrying out simulations where the RIL is cheaper by 5% and 8%.

Impact of different cost increases of RIL on the Berau macro variables

Table 10.3 indicates that there is a negative relationship between GRP level in 2025 and the level of RIL costs. As the level of RIL cost declines, the GRP level rises. At the assumption of increase in the RIL cost by -5%, 3%, 7%, the GRP level in 2025 is IDR 15,666.00 billion, IDR 14,818.44 billion, IDR 14,737.34 billion (see cols. 3,4,5 of the table). Values of other indicators in 2025 (such as household consumption, investment, etc.) under different assumption of RIL's cost increase can also be seen in the table. In addition, the table also describes changes (of value and % change) in 2025 of macro-variables under different assumptions of the RIL's cost increase from the baseline scenario (see cols. 6-13, Table 10.3).

Table 10.3 Impact of Varying Increase Costs on Berau's Macro variables

Macrovariable	Value in 2025					Value Change from Baseline (in 2025)				% Change from Baseline (in 2025)			
	Base	If cost increases by				If cost increases by				If cost increases by			
		-8%	-5%	3%	7%	-8%	-5%	3%	7%	-8%	-5%	3%	7%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
GRP	14,978,752.95	16,683,042.07	15,666,009.42	14,818,439.48	14,737,335.86	1,704,289.13	687,256.48	-160,313.46	-241,417.08	11.38%	4.59%	-1.07%	-1.61%
Hou. Cons.	2,523,248.42	3,195,947.91	2,750,189.26	2,503,170.89	2,494,151.21	672,699.49	226,940.84	-20,077.53	-29,097.21	26.66%	8.99%	-0.80%	-1.15%
Gov. cons.	1,221,571.14	1,221,571.14	1,221,571.14	1,221,571.14	1,221,571.14	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%
Investment	3,582,747.20	3,753,020.00	3,654,360.92	3,540,096.54	3,517,358.56	170,272.80	71,613.72	-42,650.66	-65,388.64	4.75%	2.00%	-1.19%	-1.83%
Exports	10,436,171.52	11,873,406.89	11,027,241.15	10,310,181.13	10,257,385.89	1,437,235.37	591,069.63	-125,990.40	-178,785.63	13.77%	5.66%	-1.21%	-1.71%
Imports	2,784,985.34	3,360,903.87	2,987,353.05	2,756,580.22	2,753,130.94	575,918.53	202,367.71	-28,405.13	-31,854.40	20.68%	7.27%	-1.02%	-1.14%
CPI	1.00	1.23	1.11	0.98	0.97	0.23	0.11	-0.02	-0.03	22.87%	10.90%	-2.07%	-2.98%
Gov. Savings	895,557.79	924,429.86	915,348.51	859,498.13	840,206.21	28,872.07	19,790.72	-36,059.66	-55,351.58	3.22%	2.21%	-4.03%	-6.18%
Net Export	7,651,186.18	8,512,503.02	8,039,888.10	7,553,600.91	7,504,254.95	861,316.84	388,701.92	-97,585.27	-146,931.23	11.26%	5.08%	-1.28%	-1.92%

Note: values are in IDR million (where applicable)

Source: Model output

The relationship between percentage change in production costs and Berau's gross regional product (GRP) seems to be a curve with a negative slope, rather than a linear relationship (see Figure 10.1). This relationship is useful to predict or interpolate the total percentage change of a particular indicator as assumptions of the RIL cost changes. For instance, if the RIL application would increase logging cost by 2%, it is predicted that there will be a total GRP level of the Berau in 2025 would be around IDR 14.9 trillion. On the other hand, if the application of RIL decreases production cost by 10%, the projected GRP gain in 2025 is expected to be around IDR 17 trillion.

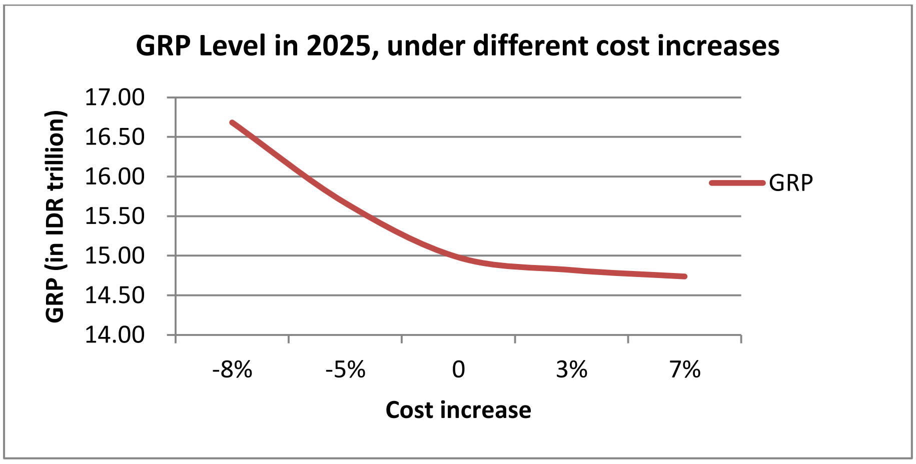


Figure 10.1 Relationship between GRP value and RIL's costs increase

Figures 10.2, 10.3 and 10.4 show the relationships between cost increase level and output values in 2025 of timber (TIMB), oil palm (OILP), forest-based industry (FOIN) and pulp and paper (PAPR). For instance, the TIMB's output level in 2025 will increase, as there the RIL's costs increase moves from 7% to -8%. On the hand, the OILPs' output level would decrease and the level of RIL's cost increase goes down (see Figure 10.2).

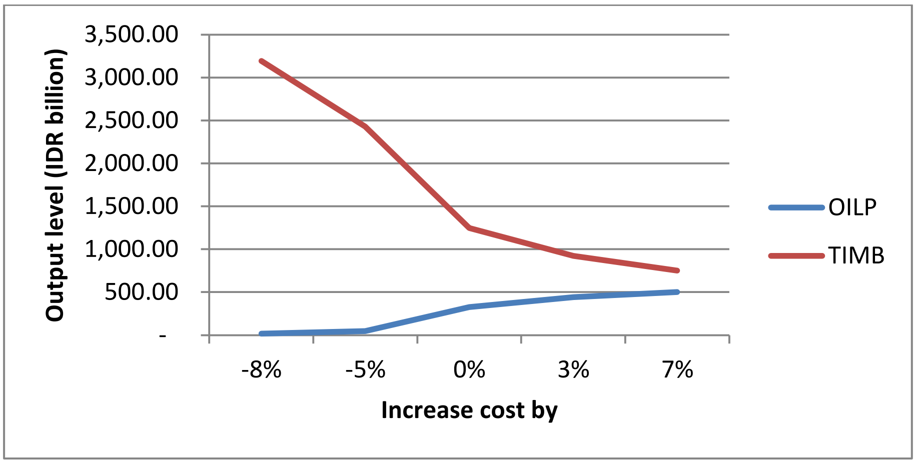


Figure 10.2 Relationship between timber (TIMB) and oil palm (OILP) outputs in 2025 and RIL's costs increase

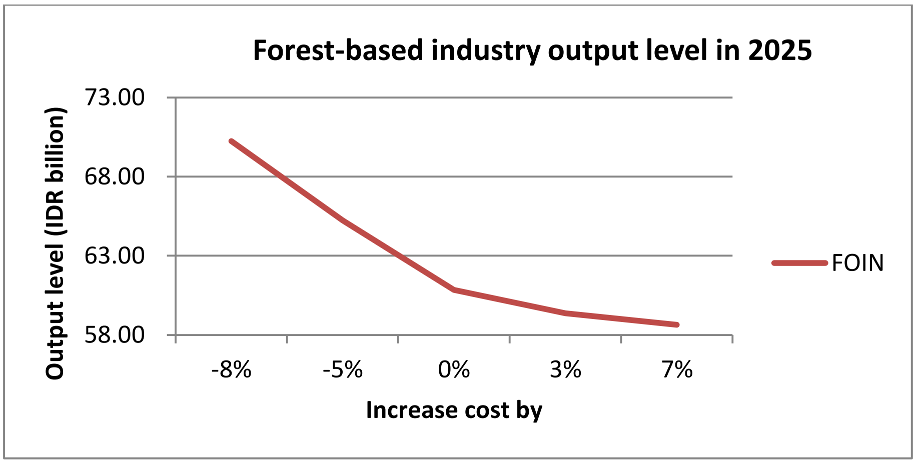


Figure 10.3 Relationship between forest-based industry output in 2025 and RIL's costs increase

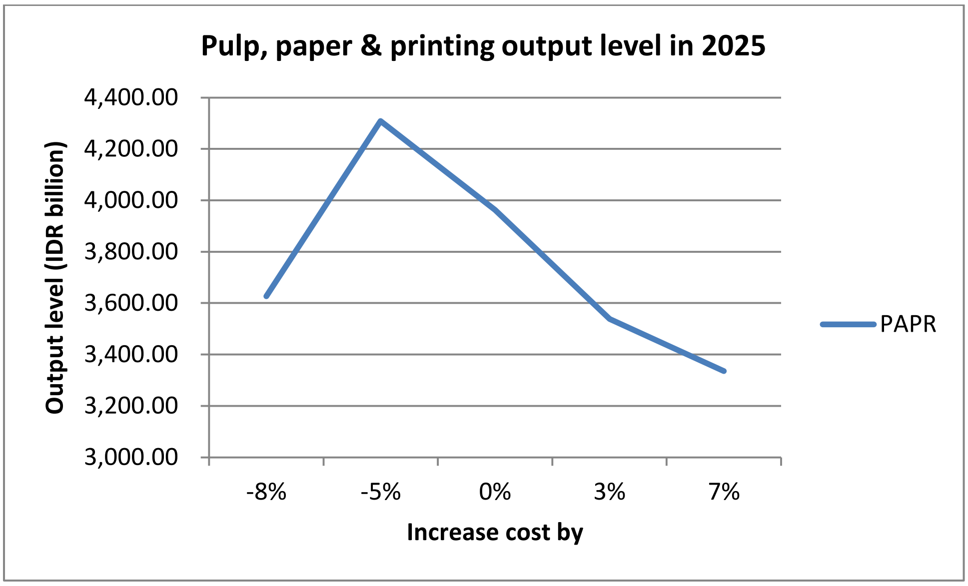


Figure 10.4 Relationship between pulp, paper & printing output in 2025 and RIL's costs increase

The pattern of relationship between FOIN and PAPR's output and the RIL's cost increase level in Figures 10.3 & 10.4 seems to be similar, except if the cost decreases below 5%. As the RIL's increase goes to -8%, the FOIN's output keep increasing, the PAPR's output falls, nonetheless. If the cost of production decreases from 5% to 8%, the TIMB output increases by 31.5% (see Figure 10.2). This pushes down the relative price of domestic timber commodity further. With such a cheaper domestic price, producers shift towards outside markets and this generates a jump of the TIMB exports by about 40% (Figure 10.5). The increase in the TIMB exports (together with a shrink in its import) creates a shortage of the TIMB supply in Berau which causes the PAPR production to fall (as the PAPR good is the main component of the PAPR production, the activity's output reduces further)[55].

[55] Note that according to Berau SAM, within each unit of PAPR good, the shares of TIMB and PAPR commodities are 18% and 30% respectively.

Figure 10.5 Relationship between timber (TIMB)'s export value in 2025 and RIL's costs increase

10.2.2 Varying Subsidy Rate Level

This section presents the simulation results with regards to varying the level of output subsidy rates in the timber sector from the original estimate of 2% to 5%, 7%, and 10%.

Macro variables of the Berau District

The impact of varying the level of subsidies on Berau's selected macro-indicators is shown in Figures 10.6, 10.7, and 10.8. Without subsidy, the GRP value in 2025 is IDR 14,737.34 billion (Note that the GRP in 2025 in the baseline is 14,978.75 billion). Increasing the log-output subsidy rate from 2% to 10% would result the GRP value in 2025 from IDR 14,760 billion to just below IDR 14,860 billion (see Figure 10.6). The respective % change of GRP in 2025 from the baseline, when simulated under the 2% and 10% subsidy rate, is -1.43% and -0.7%. This suggests that quintupling the subsidy rate (from 2% to 10%) will halve the loss of Berau GRP in 2025 (from -IDR 0.24 billion to -IDR 0.12 billion).

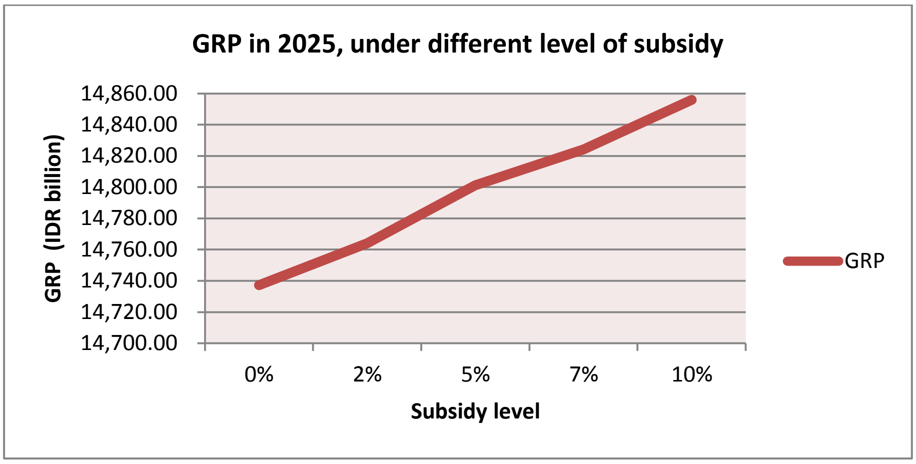


Figure 10.6 Relationship between GRP value in 2025 and subsidy level

Aggregate household consumption and investment also improves as the output subsidy rate in the TIMB output increases (see Figure 10.7). At the level of subsidy rate of 10%, the household consumption and investment in 2025 are nearly IDR 2,500 billion and IDR 3,600 billion, respectively. In the Figure, slope of the lines may represent responsiveness of the macro-indicators' level towards the change of subsidy level. The percentage change in the aggregate investment is slightly more responsive towards the change of the subsidy level than the household consumption level. For instance, as the subsidy level was increased to 10% (from 2%), the investment level in 2025 grows 102% while the household consumption in 2025 expands 101%.

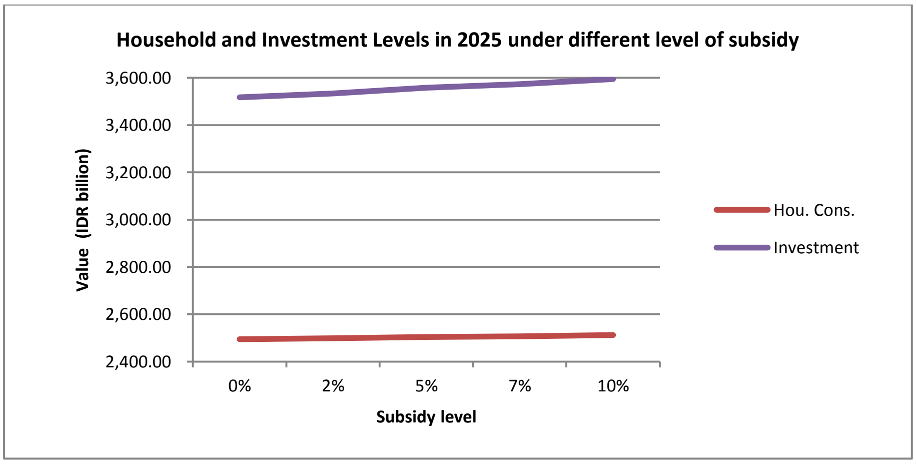


Figure 10.7 Relationship between aggregate household and investment value in 2025 and subsidy level

Impact of varying subsidy rate to selected activities' output

Figure 10.8 shows the linear relationship between the output level of timber (TIMB) and oil palm (OILP) in 2025 and the (log output-based) subsidy rate. If the impact of the policy is negative towards a particular activity, then increasing the subsidy level would reduce the magnitude of negative impact, and vice versa. For example, under the RIL+ 2% timber output subsidy, the the TIMB's output in 2025 is about IDR 775 billion and increase the subsidy rate to 10% would result in a TIMB output of around IDR 875 billion. On the other hand, increasing the subsidy level from 2% to 10% would produce the OILP in 2025 of IDR 500 billion to about IDR 450 million.

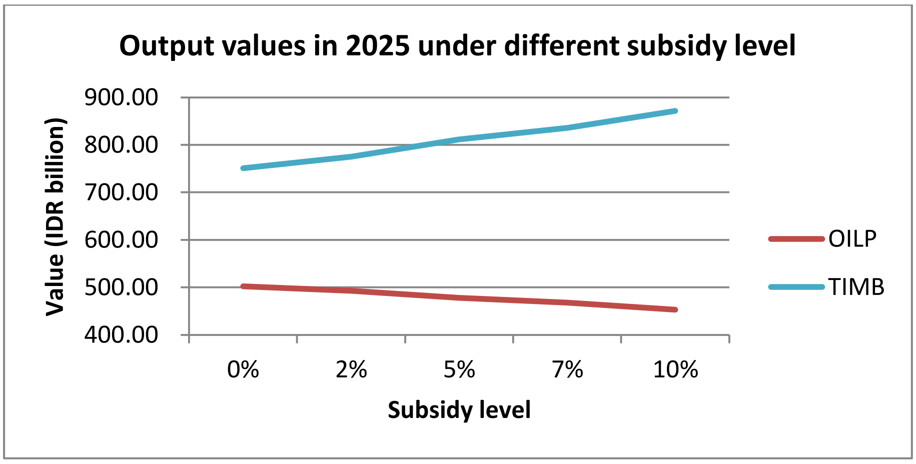


Figure 10.8 Relationship between output values of timber (TIMB) and oil palm (OILP) in 2025 and subsidy level

The relationship between the subsidy rate in the timber output and cumulative percentage changes of FOIN and PAPR seems also to be linear, as depicted in Figures 10.9 and 10.10. Without any subsidy, the output levels in 2025 of FOIN and PAPR are around IDR 58 billion and slightly above IDR 3,300 billion, respectively. As the output subsidy increases, so does the output level of the FOIN and PAPR. With the subsidy level of 10%, the output levels of the FOIN and PAPR would be IDR over IDR 60 billion and about IDR 3,900 billion, respectively. This indicates that the FOIN industry is less responsive to the increase of subsidy level than the PAPR industry.

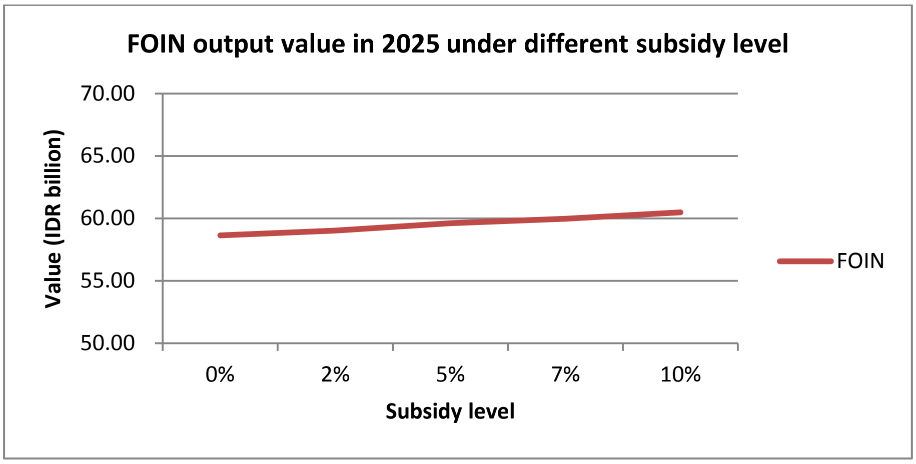


Figure 10.9 Relationship between output values of FOIN and PAPR's in 2025 and subsidy level

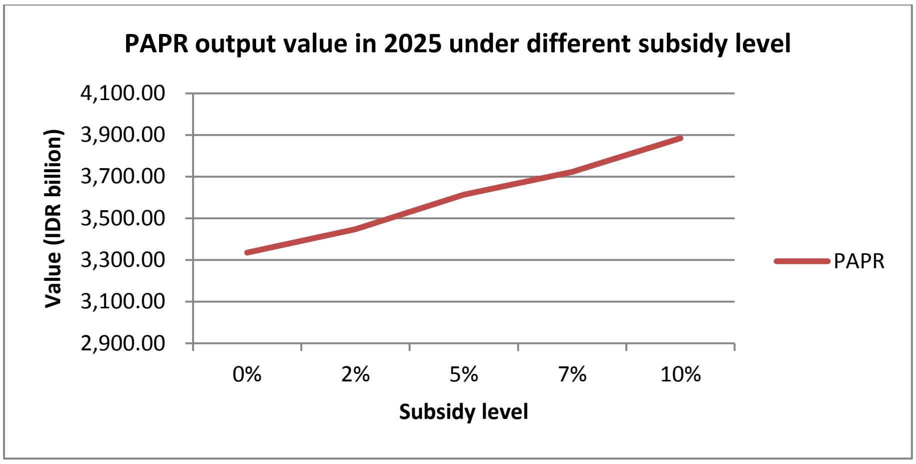


Figure 10.10 Relationship between output values of FOIN and PAPR's in 2025 and subsidy level

10.3 Conclusion

The previous chapter has demonstrated (i) sensitivity analysis with regard to a selected parameter, and (ii) varying the level of increase cost of reduced-impact logging implementation and level of output subsidy. The former aims to address the question of how robust a CGE modelling results with respect to a specific parameter. Note that there are lot of parameters used in the CGE modelling and one usually focuses on a relevant and particular parameter relevant to the focus of analysis. It was demonstrated that the model simulation of implementing RIL has been robust with regard to the selected parameter.

The second part of this chapter described a kind or magnitude degree of economic impact that the Berau may experience under a set of different levels of increase cost and incentive of implementing reduced-impact logging policy. The variation refers to experts' judgment as depicted in Chapter 8.

Chapter 11 Conclusions and Recommendations

Before stating conclusions, it is important to note that the CGE modelling simulation results of the RIL implementation need to be qualified. Since data are limited, the model employed here cannot capture perfectly all relationships within the economy, within the environment, and between the economy and the environment. In addition, the underlying assumptions for the CGE and the simulation scenarios should also be carefully scrutinised.

A. Database preparation and Model Building

- As part of Indonesian Government's programme to cut its emissions through reducing emissions from deforestation and forest degradation efforts, Berau District plans to implement the Berau Forest Carbon Programme (BFCP) commencing in 2016. The program identifies that logging sector was an important contributor to forest emissions and better logging practices through reduced-impact logging is a potential measure of the emissions reduction efforts.
- Methods to assess impact of a particular policy depend on the purpose of the study. However, common assessment evaluation of such a policy is limited to, such as, benefit-cost and/or Net Present Value analyses. It was attempted to do an assessment of economy-wide impact of the programme under computable general equilibrium framework with the main purpose was to provide insight for decision-makers and to complement existing assessments-related to the BFCP programme.
- Computable general equilibrium (CGE) model requires exhaustive information of the nation/region to be observed e.g. the Berau District. Regional accounting information i.e. social accounting matrix and input-output analysis serves as basic dataset for the CGE model. In addition, the CGE model requires a set of exogenous parameters that can be obtained from econometric data, existing literature and experts' judgment to make the model more representative. Limited information restrict the model to be a single CGE region type i.e. Berau District and the rest of Indonesia and World

- It was unfortunate that relevant dataset for CGE Analysis of the Berau District is not available and other pertinent information is limited. The District's social accounting matrix was constructed using information derived from the most updated East Kalimantan Province Input-Output Table, and utilising the cross-hauling approach (Kronenberg, 2007). This was complemented with various resources like published and unpublished information of the District (from the Berau District Statistics Office, the East Kalimantan Province Statistics Office and National Statistics Office), available literatures on Indonesia, and relevant statisticians/experts familiar with the study.
- Despite the fact that there are ample of CGE application for Indonesia, this seems to be the first endeavour to use a recursive dynamic CGE analysis to review a forestry-related policy at the district level. The model's strength, as it is a nature of a comprehensive general equilibrium framework, is to allow one to understand the complex interdependency and feedback effect between policy intervention and activities in an economy.
- An innovation of this research is that the integration of results of experts' opinion survey with the regional CGE model. Most CGE modelling simulations employ model parameter changes, which is based on a certain assumption that reflects a policy implementation. In this research, the parameter change was inferred from information derived from an experts opinion survey.

B. Estimating the impact of reduced-impact logging (RIL) and level of compensation for applying the RIL:

- Implementing emissions reduction measures may result in increased costs for forest stakeholders. For example, logging companies have been identified as important forest stakeholders that can contribute to an emissions reduction programme in the Berau District through the implementation of reduced-impact logging (RIL). There is likely to be a cost imposed on the logging company following RIL practice. If so, (financial) compensation should be provided to ensure the company would fully participate in the program.

- Expert opinions survey method was utilised to confirm and complement various existing information concerning the impact of the RIL to production/logging cost. In the case of Berau District East Kalimantan Province, aggregate RIL-related experts' opinion suggests that applying the RIL technique would cause an incremental cost increase of 7%. The incremental increase of logging costs was supported by some literature, as presented in section 8.2.1.
- The surveyed experts estimate that a financial incentive of US$ 35/ha per year will be required by the forest company to maintain the RIL application. Since the BFCP has not decided the type of incentive given to logging companies, it was assumed that the output subsidy to logging sector would be given. Taking taken into account the total annual forests logged in the District and the estimate of total output value the in logging sector from the Berau Social Accounting Matrix, it was estimated that the rate of subsidy achieved would be 2%. The assumed subsidy rate is employed as an input to the Berau CGE model simulation.
- However, the current programme in the District suggests that it is not clear the amount of incentive required and mechanism on how the payment will be delivered. At this stage, an output-based subsidy for log production was selected and considered as a performance-based type of incentive.

C. Impact of Applying RIL to the Berau Economy

If the Berau District plans to implement RIL technique in its logging sector, conclusion and recommendation made are:

- The impact of applying RIL policy without any financial compensation is negative to the Berau economy is negative. It is estimated that the District's GRP in 2025 will be 1.61% below the baseline GRP in 2025, which is about IDR 241.42 billion. Furthermore, there are also losses in other macro-indicators like household consumption, investments, exports and imports and their losses are below 2% their respective baseline.
- Providing compensation of 2% output subsidy in the logging sector would reduce the magnitude of RIL's impact on Berau economy. However,

simulation results show that such reduction is marginal. For example, there is only 0.18 percentage point improvement in the Berau's GRP of 2025 from the level of GRP in 2025 that otherwise would occur in the absence of the compensation. There are also small gains in the aforementioned macro-indicators, as an effect of the subsidy, which range between 1.88% and 6.34%. The largest improvement occurs in the aggregate investment (6.34%) which is attributed to significant gain in the government's saving.

- Under the RIL0 scenario, worker household type is significantly negatively affected. Total consumption losses in forestry worker households – HFW, forestry self-employee households – HFSE, agriculture worker households – HAW and agriculture self-employee households – HASE are IDR 44.25 billion, IDR 29.78 billion, IDR 21.79 million and IDR 129.46 billion respectively. These are equivalent to -113%, -101%, -107% and -46.43% of their corresponding consumptions in. The impact is greater in the agricultural worker households like HFW and HAW than in the self-employee agricultural households (HFSE and HASE) because the relative price of agricultural paid-labour (LAP), a major contributor of the income in the HFW (56%) and HAW (34%) households, falls the most.

- When the implementation of the RIL is accompanied by an output subsidy of 2% rate in the logging sector, the impact in household consumption is reduced from the level that would happen in the RIL0 Scenario. Total changes in 10 years for the respective HFW, HFSE, HAW, and HASE's consumptions are IDR 40.84 billion, IDR 27.08 billion, IDR 20.10 billion, and IDR 119.35 billion, which is equal to -104%, -91.73%, -98.95%, and -42.80%, respectively of their consumption levels in 2015.

- The impact of the RIL policy is negative and large on the logging sector. Under the RIL0 policy, total changes in 10 years' simulation of the TIMB and OFOP are IDR -2.756.81 billion and IDR -17.27 billion, respectively. These are about -434.37% and -22.29% of their output values in 2015. Providing incentive, as in the RIL2 Scenario, decreases the magnitude of impact. Under this scenario, the total changes in the TIMB and OFOP are IDR -2.23.83 billion and IDR -11.78 billion; suggesting a gain of IDR 232.98 billion in TIMB and IDR 5.49

billion in OFOP from what would happen in the RIL0 scenario. The RIL policy causes other agricultural sectors' output to raise, particularly on the Oil palm sector, which is positively large.

- Within the manufacturing group, being the consumer of the timber commodity, the forest-based industry and pulp-paper industry is negatively affected by the RIL policy. Under the RIL0 policy, the FOIN and PAPR's outputs are almost 0.3% and 3% below baseline in 2013 to nearly 4% and 16%, respectively, in 2025. The impact is greater in the PAPR than in the FOIN since the PAPR consumes 48% of the TIMB's output (while the FOIN's consumption of the TIMB commodities is 1%). Total differences in the respective FOIN and PAPR outputs under the RIL0 policy are IDR -12.09 billion and IDR -3.546.133 billion. Under the RIL2 scenario, there are gains of IDR 2.86 billion and IDR 873.77 billion, for the FOIN and PAPR, respectively. Due to higher absorption of the TIMB commodity, positive effect of the output subsidy in the TIMB's sector is more obvious in the PAPR activity rather than in the FOIN.
- A sensitivity analysis was carried out to test the robustness of simulation results with respect to constant elasticity of substitution (CES) between primary inputs in agricultural group by applying the RIL scenario without any compensation. It was assumed that the parameters are critical in determining simulation results. A 20% of upper and lower bound was arbitrary selected, following Hosoe (2010) and consequently, there are three cases low CES, medium (original), and high CES. The sensitivity analysis results suggest that impacts of the RIL policy on macro indicator and activities' output are robust as (i) sign of (output) changes are unchanged and (ii) ordering of the output changes are unchanged when simulated under the three cases of CES.
- Suppose that With respect to variation of experts' opinion on RIL's impact on logging cost increase and required level of incentive, simulations were conducted by varying the percentage of logging cost increase and rate of timber output subsidy.
- However, from the production side of economy, care should be paid since the RIL policy signals the 'unexpected' emissions leakage indicated by increases in output of some agricultural-based activities such as oil palm plantation, other

estate crops, and food crops which leads to forest-land requirement for their increasing production. Therefore it is deemed necessary that applying the RIL policy should be complemented with emissions reduction efforts in the other agricultural sectors particularly Oil Palm plantation.

- Simulation results of implementing RIL also indicate that there is an increase of import in timber commodities. Consequently, there may be an increase of logging production in other part of Indonesia (rest of world). This suggests that that emission reduction effort should be carefully and comprehensively implemented across the country. Otherwise,
- In this research, the compensation was set as an output-based subsidy in the timber/logging sector. Future modelling analysis is required to observe the potential economic impact of providing alternative setting of subsidy. The alternative form of subsidy may include treating compensation as factors of production subsidy (e.g. subsidising land factor), and/or providing direct transfer to the potentially affected households.
- Oil palm sector is a growing economy in Indonesia and in the Berau District. The growth of this sector is accused on the scarification of the existing forests. According to the BFCP documents, the Berau District plans to divert establishing new oil palm to available already degraded land, away from currently plan of converting nearly 200,000 ha of the allocated forested land. Future modelling research that includes establishment of new oil palm plantation on both currently forested lands and the policy alternative of establishing the new oil palm on already degraded land is recommended.
- Finally, provide that required information are available, there is also opportunity to look at developing a berau CGE model which involves the set of emissions reduction target, such as in the work of Yusuf and Warr (2010). The may include possible emissions reduction target as from the whole District or assigned by the contributing sectors.

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Appendix 6.1 Sectoral Distribution of the 2007 East Kalimantan Input-Output Table

No	Sector (Activity)	Description
1	Paddy	Includes paddy of dry land and paddy from irrigated land
2	Cassava	Cassava
3	Vegetables	Includes tomato, carrot, chilli, spinach and other vegetables
4	Fruits	Includes banana, orange, avocado, and other fruit crops
5	Other foods	Includes sweet potato, potato, red bean, soy bean, peeled bean and other foods
6	Pepper	Pepper plantation
7	Oil palm	Oil palm plantation
8	Other estate crops	Rubber, coconut, coffee, sugar cane, and other estate crops
9	Poultry	Chicken meat and eggs
10	Other livestock	Includes cows, sheep, buffalo, pigs, lambs
11	Timber	Natural and planted logs
12	Other forest products	Swiftlet nests, rattan, nests of hunting, other non-timber forest products and other forest services, and non domestic animal breeding
13	Marine fishery	Sea fish, shrimp, and other captures, shell cultivation, other marine fishery services
14	Inland fishery	Pond and other land fisheries
15	Oil and natural gas mining	Oil, natural gas, and geothermal
16	Coal	Coal mining
17	Other non oil and natural gas	Gold and silver ore mining
18	Quarrying	Stone, kaolin, ceramic, and sand mining
19	Oil refinery	Oil refinery industry
20	Liquid natural gas industry	Liquid natural gas refinery industry
21	Food and beverage industries	Bakery, food and beverage, rice mill, and crude palm oil processing
22	Textile, leather and foot-based industries	Clothing industry and other textile industries
23	Timber and other forest products industries	Plywood, sawn wood, furniture, and products of bamboo and rattan
24	Paper and printing industries	Pulp and paper, paperboard, paper for packaging, printing and binderies
25	Fertiliser, chemical and rubber-based industries	Organic based chemical and others
26	Cement and its associated industries	Cement and others
27	Steel industry	Steel industry
28	Transportation, machinery and tool industries	Machinery including heavy machinery and services
29	Other product industries	Jewellery, musical instrument industries, and other than previously categorised industries
30	Electricity	Electricity
31	Water	Drinking water
32	Construction	Housing, offices, shops, stadiums, fish ponds, farms
33	Trade	Wholesale and retail
34	Hotel	Hotels and motels
35	Restaurant	Restaurants and other food stalls
36	Land transportation	Passengers and goods transportation
37	River transportation	Speed boat, ferry and other river transportation
38	Marine transportation	Marine transportation
39	Air transportation	Air carriers
40	Transportation supporting services and warehouses	Transportation services, agents, and warehouses
41	Communication	Post, telephones, cellular phones
42	Banking	Banking
43	Other financial services	Insurance, mortgages, cooperatives and money changers
44	Rental service	Building rentals
45	Company service	Legal, accounting, data processing, architects, advertising, marketing research, and non building rentals
46	Government and defence	Government
47	Social and community services	Health services, formal and non formal education, NGOs, and other community organisations
48	Entertainment service	Cinema, commercial photography, and other entertainment activities
49	Individual and household services	Individual workshops, mechanics,
50	Uncategorised activities	Other activities not included in the above categories

Source: The Statistics Office of East Kalimantan Province 2007 (*BPS Kalimantan Timur* 2007)

Appendix 6.2 The Berau District and East Kalimantan Province's Sectoral Distribution, and Share of Domestic Products

No	2007 Berau District Sectoral Distribution	Berau Domestic Products (in Million Rupiah)	No	2007 East Kalimantan Sectoral Distribution	Disaggregated Berau Domestic Products [2])	East Kalimantan Domestic Products [3])	Share of Domestic Products
	(1)	(2)		(3)	(4)	(5)	(6)
1	Food crops	131,322.69	1	Paddy	77,832.74	1,012,048.76	0.077
			2	Cassava	28,246.34	156,975.23	0.180
			3	Vegetables	8,583.66	637,954.32	0.013
			4	Fruits	-	667,890.09	-
			5	Other foods	16,659.96	151,265.61	0.110
2	Estate crops	91,007.76	6	Pepper	40,407.45	193,864.82	0.208
			7	Oil palm plantation	11.28	907,767.18	0.000
			8	Other estate crops	50,589.03	561,421.55	0.090
3	Livestock	13,819.15	9	Poultry	7,145.96	490,026.88	0.015
			10	Other livestock	6,673.20	557,291.87	0.012
4	Forestry	415,924.58	11	Timber	374,332.12	3,149,840.99	0.119
			12	Other forest products	41,592.46	389,652.20	0.107
5	Fishery	181,399.76	13	Marine fisheries	136,447.37	840,774.17	0.162
			14	Land fisheries	44,952.39	1,726,552.27	0.026
6	Oil and natural gas	-	15	Oil and natural gas	-	59,908,111.11	-
7	Mining (Non oil and natural gas) - Coal and others	1,630,952.67	16	Coal	1,630,952.67	28,900,994.35	0.056
			17	Other non oil and Natural gas mining	-	1,327,527.97	-
8	Quarrying	7,816.25	18	Quarrying	7,816.25	1,125,269.79	0.007
9	Oil and natural gas industry	-	19	Oil refinery	-	24,401,505.67	-
			20	Liquid natural gas Industry	-	41,449,221.63	-
10	Food and beverages Industry	1,474.93	21	Food and beverages Industry	1,474.93	1,326,393.11	0.001
11	Textile industry	597.99	22	Textile, leather and foot-based industry	597.99	44,790.78	0.013
12	Timber industry	6,059.07	23	Forestry industry	6,059.07	2,587,411.72	0.002
13	Paper and printing Industry	629,500.42	24	Paper and printing Industry	629,500.42	2,435,044.37	0.259
14	Mining material Industry	2,934.75	25	Fertiliser, chemical and Rubber-based industry	2,934.75	2,699,537.50	0.001
			26	Cement and associated industry	-	152,479.59	-
			27	Steel industry	-	-	-
			28	Transportation, machinery and tools Industry	-	139,041.82	-
15	Other type industry	2,455.36	29	Other type industry	2,455.36	99,375.00	0.025
17	Electricity	8,106.84	30	Electricity	8,106.84	451,664.58	0.018
18	Water	568.72	31	Water	568.72	125,313.12	0.005
19	Construction	52,515.99	32	Construction	52,515.99	7,290,988.01	0.007
20	Trade	538,349.08	33	Trade	538,349.08	14,217,092.04	0.038
21	Hotel	8,822.71	34	Hotel	8,822.71	339,859.90	0.026
22	Restaurant	15,511.28	35	Restaurant	15,511.28	904,082.99	0.017
23	Land transportation	54,055.70	36	Land transportation	54,055.70	1,345,646.90	0.040
24	River transportation	8,446.40	37	River transportation	8,446.40	633,139.72	0.013
25	Marine transportation	265,657.65	38	Marine transportation	265,657.65	778,248.98	0.341
27	Air transportation	17,212.81	39	Air transportation	17,212.81	733,618.49	0.023
28	Supporting transportation service	1,961.66	40	Transportation supporting services and warehouses	1,961.66	2,129,220.19	0.001
29	Communication	31,662.42	41	Communications	31,662.42	1,553,612.57	0.020
30	Banking	2,458.25	42	Banking	2,458.25	1,043,123.05	0.002
31	Other financial services	3,055.55	43	Other financial services	3,055.55	249,688.94	0.012
32	Rentals	22,286.23	44	Rentals	22,286.23	1,807,813.74	0.012
33	Company services	635.61	45	Company services	635.61	2,085,929.04	0.000
34	Government	186,361.56	46	Government and defence	186,361.56	7,292,019.68	0.026
35	Social and community service	4,028.08	47	Social and community services	4,028.08	274,541.19	0.015
36	Entertainment and recreation	433.99	48	Entertainment services	433.99	74,334.75	0.006
37	Individual and household services	7,331.36	49	Individual and household services	7,331.61	561,920.81	0.013
			50	Uncategorised activities	-	-	-
	Total	**4,344,727.27**		**Total**	**4,344,727.52**	**221,931,889.00**	**0.020**

Sources:

Column 1 : The Berau District Statistics Office, 2008

Column 4 : Gross Regional Domestic Product of Regency/City in East Kalimantan by Industrial Origin, 2003-2008, the Statistics Office of East Kalimantan Province

Column 5 : Analysis of 2007 East Kalimantan Input Output Table [*Analisis Tabel Input-Output Kalimantan Timur* 2007 available in Bahasa Indonesia], the Statistics Office of East Kalimantan Province

Appendix 6.3 A Complete Code for the Berau District SAM

No	Code	Descriptions
		Factor of production
1	LAP	Agriculture paid labour/worker
2	LANP	Agriculture non-paid labour/worker
3	LNAP	Non-agriculture paid labour
4	LNANP	Non-agriculture non-paid labour
5	CAP	Capital
6	LAND	Land factor
		Institutions (Household groups, Enterprise & Government)
7	HFW	Forestry Worker Households
8	HFSE	Forestry Self-employed Households
9	HAW	Agricultural worker household
10	HASE	Agricultural self-employed household
11	HNAW	Non-agricultural worker household
12	HNASE	Non-agricultural self employed household
13	HOTH	Other household (e.g. pension)
14	ENT	Enterprise
15	GOVE	Government
		Activities/Commodities
16	FCRO	Food agriculture
17	OILP	Oil Palm
18	OESC	Other estate crops
19	LIVS	Livestocks
20	TIMB	Timber/Logging
21	OFOP	Non-timber forest products
22	FISH	Fisheries
23	COAL	Coal, oil & natural has, other non oil & natural gas mining
24	QUAR	Quarrying
25	FBIN	Food and beverages industries
26	TEXL	Textile, leather and foot-based industries
27	FOIN	Forestry-based industry
28	PAPR	Pulp, paper and printing industries
29	OILR	Oil refinery, LNG, and other industries
30	FERC	Fertiliser, chemical and rubber-based industries
31	ELWT	Electricity & water
32	CONS	Construction
33	TRAD	Trade, hotel & restaurant
34	TRAN	Transportations
35	COMM	Communications
36	FINA	Financial service
37	SERV	Rentals & company services
38	PUBO	Public, defense, and other services
39	S-I	Saving-Investment
40	NIT	Net Indirect Taxes
41	ROW	Rest of World (Berau)

Appendix 6.4 Elasticity parameters for the Berau CGE Model

Commodities	Elasticity of substitution domestic & imported commodities	Elasticity of Transormation between domestic and exported commodities	Elasticity of Substitution between primary inputs
FCRO	0.75	1.25	0.75
OILP	0.75	1.25	0.75
OESC	0.75	1.25	0.75
LIVS	0.75	1.25	0.75
TIMB	0.75	1.25	0.75
OFOP	0.75	1.25	0.75
FISH	0.75	1.25	0.75
COAL	0.5	1.5	0.5
QUAR	0.5	1.5	0.5
FBIN	1.5	2	1.5
TEXL	1.5	2	1.5
FOIN	1.5	2	1.5
PAPR	1.5	2	1.5
OILR	0.5	1.5	0.5
FERC	0.5	2	0.5
ELWT	0.5	2	0.5
CONS	1.5	2	1.5
TRAD	2	0.5	2
TRAN	0.5	0.5	0.5
COMM	0.5	0.5	0.5
FINA	1.25	0.5	1.25
SERV	1.25	0.5	1.25
PUBO	1.25	0.5	1.25

Source: Robinson et al. (1997).

Appendix 6.5 Estimate of the 2007 Berau District's Social Accounting Matrix

		LAP	LANP	LNAP	LNANP	CAP	LAND	HFW	HFSE
		1	2	3	4	5	6	7	8
LAP	1								
LANP	2								
LNAP	3								
LNANP	4								
CAP	5								
LAND	6								
HFW	7	19,617.54	7,728.06	11,140.75	2,507.61	599.79	9.61	234.02	286.82
HFSE	8	4,339.46	20,010.62	9,006.97	4,424.38	1,630.28	21.77	306.85	376.06
HAW	9	10,995.39	4,393.58	8,485.29	1,465.32	456.76	5.18	617.18	756.33
HASE	10	50,834.88	85,118.29	42,288.23	23,493.06	7,582.52	125.10	1,751.47	2,146.64
HNAW	11	9,101.74	16,352.49	218,474.64	59,150.83	24,651.45	123.98	3,708.77	4,545.12
HNASE	12	9,795.78	52,677.90	226,920.89	88,296.86	42,729.10	178.65	2,546.31	3,120.33
HOTH	13	6,904.26	23,954.02	55,502.75	33,655.05	10,400.88	50.15		
ENT	14					1,048,125.43	1,468.62		
GOVE	15							12,575.88	15,407.86
AFCRO	16								
AOILP	17								
AOESC	18								
ALIVS	19								
ATIMB	20								
AOFOP	21								
AFISH	22								
ACOAL	23								
AQUAR	24								
AFBIN	25								
ATEXL	26								
AFOIN	27								
APAPR	28								
AOILR	29								
AFERC	30								
AELWT	31								
ACONS	32								
ATRAD	33								
ATRAN	34								
ACOMM	35								
AFINA	36								
ASERV	37								
APUBO	38								
CFCRO	39							3,599.81	2,879.82
COILP	40								
COESC	41							221.15	107.58
CLIVS	42							770.55	950.94
CTIMB	43								
COFOP	44							15.02	10.13
CFISH	45							1,377.20	950.24
CCOAL	46								
CQUAR	47								
CFBIN	48							4,100.53	3,388.22
CTEXL	49							672.07	655.77
CFOIN	50							560.71	279.61
CPAPR	51							388.86	280.61
COILR	52							3,803.12	2,158.83
CFERC	53							414.16	299.12
CELWT	54							147.11	405.76
CCONS	55								
CTRAD	56							1,194.40	1,685.61
CTRAN	57							3,709.21	1,847.23
CCOMM	58							76.19	294.42
CFINA	59							53.79	205.64
CSERV	60							724.46	351.42
CPUBO	61							745.24	305.44
SI	62							308.20	518.46
NIT	63								
ROW	64	44,953.02	3,530.96	817,583.71	111,159.40	252,587.82		1,257.38	1,232.27
TOT	65	156,542.07	213,765.92	1,389,403.22	324,152.51	1,388,764.03	1,983.06	45,879.66	45,446.30

HAW	HASE	HNAW	HNASE	HOTH	ENT	GOVE	AFCRO	AOILP
9	10	11	12	13	14	15	16	17
							12,574.22	15,032.36
							57,199.98	18,307.85
							150.36	3,487.03
							542.90	221.76
							49,881.62	18,852.63
							338.40	129.49
256.03	573.76	790.87	992.43		372.91	760.41		
335.39	771.83	1,086.72	1,376.86		559.44	1,183.13		
674.01	1,588.42	2,279.43	2,912.98		1,269.48	2,773.92		
1,916.46	4,276.34	5,874.24	7,359.83		2,730.63	5,535.28		
4,051.89	9,443.32	13,431.37	17,095.47		7,209.95	15,515.43		
2,779.22	6,654.22	9,670.72	12,429.68		5,675.38	12,673.80		
					21,852.89			
13,681.37	35,924.81	56,211.80	74,705.24		146,003.11	113,488.40		
2,313.66	26,207.86	15,217.63	21,339.86	2,293.45		3,104.07	9,143.55	
								22,609.59
65.14	1,065.62	1,024.63	1,323.33	150.87		7.09		
427.66	5,171.43	5,175.80	5,709.83	357.46			334.11	171.33
							6.44	7.24
7.17	270.15	593.86	1,117.18	109.65				
603.52	15,580.59	17,734.32	19,973.06	3,683.43		125.85	0.77	0.62
2,682.07	18,873.36	17,216.97	11,327.65	4,304.14		394.34	91.69	
190.26	3,653.78	2,222.72	2,417.56	539.51		13.40	43.59	2.65
279.48	2,280.57	3,822.43	3,297.82	1,155.35		699.91	8.35	
190.37	3,739.37	10,073.22	12,272.53	4,461.14		62,498.69	14.58	124.18
1,325.15	20,631.34	18,309.09	15,171.01	3,643.89		3,368.01	273.11	1,482.42
205.51	2,759.40	5,482.89	5,820.03	4,052.84		883.06	7,542.81	5,382.87
225.44	3,622.80	3,726.71	3,583.41	893.86		3,430.38	10.03	31.92
						14.57	581.95	2,693.68
586.07	21,107.24	55,283.77	61,571.13	28,587.34		34,124.37	1,341.55	1,268.70
1,820.22	23,063.71	37,995.67	29,268.51	17,574.81		50,822.96	507.55	1,389.16
37.56	3,254.89	5,951.73	7,417.12	2,416.47		14,721.89	0.29	222.09
26.70	1,877.12	2,889.38	4,129.32	1,081.84		546.47	523.98	1,272.42
358.91	3,385.61	10,445.39	7,752.53	3,680.76		1,028.52	402.52	53.35
367.24	3,403.83	7,727.47	5,929.59	2,839.37		177,305.78	204.93	2,171.99
1,242.98	16,118.09	80,708.33	129,829.38	48,640.96	316,439.96	262,257.43		
2,060.32	5,751.84	11,973.81	10,093.17		570,100.32	582,867.19		
38,709.79	**241,051.29**	**402,920.98**	**476,216.52**	**130,467.12**	**1,072,214.06**	**1,350,144.33**	**141,719.30**	**94,915.34**

AOESC	ALIVS	ATIMB	AOFOP	AFISH	ACOAL	AQUAR	AFBIN	ATEXL	AFOIN
18	19	20	21	22	23	24	25	26	27
5,943.05	3,604.79	67,712.03	9,356.39	42,319.24					
7,332.63	4,463.26	68,400.56	10,294.75	47,766.90					
2,157.62	813.61	33,881.84	4,062.20	4,929.63	718,616.42	1,939.74	495.61	289.92	1,955.04
679.89	52.57	10,037.62	1,306.65	1,176.17		2,290.06	197.01	78.17	1,443.37
8,383.99	3,784.10	135,552.85	13,481.31	65,150.92	572,813.45	1,919.26	353.22	183.08	1,872.29
58.17	26.69	886.06	94.44	449.82					
	300.46	900.04		163.23			2,404.05		
							2,326.36		
1,981.53	25.03						88.66	26.64	22.35
46.62	502.99			3.50			133.70	25.14	
32.00	4.33	6,340.84	1.54	388.47	608.70	12.98	5.17	0.96	4,699.97
		38.10	1.79	64.99			2.13	5.33	74.94
0.32				7,024.92			251.04	3.50	421.26
					286,134.55				
						1.13			
77.59	5,155.06			4,847.77			566.76	31.60	7.23
16.96		26.74	21.71	1,981.54	8.43	1.41	0.13	377.00	19.78
106.25	2.48			46.56		7.31	16.65	17.39	1,962.41
7.23	7.39	400.43	153.69	40.45	659.60	6.25	30.73	15.12	16.49
162.89	17.10	9,233.68	568.57	10,605.70	859.61	622.32	89.29	106.10	735.95
2,768.37	247.57	198.90	40.48	208.62	517.94	248.04	72.00	111.32	898.86
25.00	7.12	262.16	102.25	93.22	486.20	3.91	58.64	48.84	50.51
1,316.61	15.28	6,352.58	1,597.59	193.41	304.90	371.14	2.53	8.85	46.01
698.27	998.63	8,833.55	234.16	7,208.56	15,226.51	372.04	560.27	137.97	1,842.06
561.05	292.29	7,070.23	280.20	1,661.77	51,130.99	400.83	152.87	201.40	1,194.95
50.48	0.44	94.84	20.89	39.22	966.32	5.56	3.98	25.89	34.82
211.37	48.60	1,873.50	114.97	1,234.82	103.75	78.93	22.92	70.50	109.45
24.86	0.85	5,996.65	428.09	92.39	1,563.08	212.62	15.69	36.31	187.52
117.13	13.46	279.60	2,193.53	107.69	337.55	212.48	18.92	6.87	78.98
32,759.88	20,384.10	364,372.82	44,355.19	197,799.52	1,650,338.01	8,706.00	7,868.34	1,807.91	17,674.25

APAPR	AOILR	AFERC	AELWT	ACONS	ATRAD	ATRAN	ACOMM	AFINA	ASERV
28	29	30	31	32	33	34	35	36	37
234,583.98	1,003.11	989.61	5,240.12	21,058.76	94,481.98	86,702.83	12,678.29	3,020.72	6,935.10
56,694.93	265.57	310.49	144.01	6,530.61	153,710.23	66,699.27	3,527.58	67.45	2,568.75
200,210.30	678.31	529.88	2,961.31	12,167.23	169,455.11	80,563.74	11,942.50	1,496.15	6,436.45
	2.66	4.69			5,488.20	8,765.95			
626.29	1,455.36	35.29			180.45	65.12			
	423.85	2.65			1,970.50	1,714.20			
209,328.45	23.10	0.55		14,946.75	180.50	26.03			
1,701.08	265.80	2.41		7.81	90.32				
	502.73	0.21			3,385.96	3,126.64			0.51
	582.85	3,495.97	3,748.88						
0.29	22.68	3.93		12,382.47					
260.34	87.02	72.18	1.03	6.43	3,564.44	10,414.77	26.78	2.09	86.85
19.40	191.29	3.34	2.55	2.89	63.32	26.71	4.53	0.31	5.31
31.53	106.09	12.62	2.06	20,663.23	794.09	40.39	11.13	3.30	4.30
345,435.38	175.49	56.81	23.75	752.86	40,489.14	1,703.09	301.00	58.86	118.94
4,624.83	1,930.00	392.67	6,908.14	66,358.26	9,484.02	86,681.56	1,299.17	64.34	658.13
3,920.95	108.09	2,048.34	184.66	7,993.47	4,473.80	1,614.53	37.59	8.55	30.21
1,298.51	147.55	51.83	1,838.73	229.36	5,505.72	1,140.43	529.28	80.56	72.91
18.24	0.97	3.87	233.95	149.92	1,449.98	906.40	1,134.64	57.89	1,409.23
70,474.82	1,718.60	378.91	1,307.75	35,494.34	27,208.56	72,832.85	522.58	70.78	331.82
20,753.47	876.31	355.15	345.88	11,399.57	39,048.22	99,486.68	2,001.02	193.03	366.99
1,590.26	67.34	26.01	56.47	765.12	7,357.02	2,166.14	1,939.54	286.83	290.64
1,256.31	370.29	31.33	102.83	1,109.04	2,456.88	1,055.45	316.03	905.51	597.72
740.40	159.80	66.44	908.39	10,297.90	17,480.61	2,050.54	1,891.19	975.52	703.01
1,447.30	22.05	18.39	212.84	453.71	1,403.08	5,851.46	190.44	154.50	170.85
1,155,017.05	11,186.92	8,893.59	24,223.32	222,769.72	589,722.15	533,634.79	38,353.31	7,446.38	20,787.71

APUBO	CFCRO	COILP	COESC	CLIVS	CTIMB	COFOP	CFISH	CCOAL
38	39	40	41	42	43	44	45	46
149,929.69								
15,607.44								
30,094.34								
	141,719.30							
		94,915.34						
			32,759.88					
				20,384.10				
					364,372.82			
						44,355.19		
							197,799.52	
								1,650,338.01
353.12								
37.13								
122.87								
0.18								
23.38								
69.99								
288.81								
21.91								
32.43								
386.33								
2,149.17								
988.42								
322.78								
86.90								
1,775.26								
736.44								
428.05								
109.09								
989.74								
460.47								
	10,635.21	7,674.32	2,746.98	1,074.13	57,861.16	2,996.72	19,607.08	339,522.80
	12,160.84		10,607.66	6,279.83	13,355.43	309.78	3,528.21	214.57
205,013.96	164,515.35	102,589.66	46,114.52	27,738.06	435,589.40	47,661.69	220,934.80	1,990,075.39

CQUAR	CFBIN	CTEXL	CFOIN	CPAPR	COILR	CFERC	CELWT	CCONS	CTRAD
47	48	49	50	51	52	53	54	55	56
8,706.00									
	7,868.34								
		1,807.91							
			17,674.25						
				1,155,017.05					
					11,186.92				
						8,893.59			
							24,223.32		
								222,769.72	
									589,722.15
1,667.20	429.09	46.82	788.36	138,011.21	508.37	1,104.77	330.13	12,759.40	145,035.75
2,086.64	83,547.60	11,396.32	23,220.12	2,182.64	476,415.53	54,904.08	3,879.68		2,479.39
12,459.84	91,845.03	13,251.05	41,682.73	1,295,210.90	488,110.81	64,902.44	28,433.13	235,529.11	737,237.29

CTRAN	CCOMM	CFINA	CSERV	CPUBO	SI	NIT	ROW	TOT
57	58	59	60	61	62	63	64	65
								156,542.07
								213,765.92
								1,389,403.22
								324,152.51
								1,388,764.03
								1,983.06
							9.04	45,879.66
							16.55	45,446.30
							36.50	38,709.79
							18.34	241,051.29
							64.54	402,920.98
							67.67	476,216.52
								130,467.12
							767.13	1,072,214.06
						870,116.71	12,029.15	1,350,144.33
								141,719.30
								94,915.34
								32,759.88
								20,384.10
								364,372.82
								44,355.19
								197,799.52
								1,650,338.01
								8,706.00
								7,868.34
								1,807.91
								17,674.25
								1,155,017.05
								11,186.92
								8,893.59
								24,223.32
								222,769.72
								589,722.15
533,634.79								533,634.79
	38,353.31							38,353.31
		7,446.38						7,446.38
			20,787.71					20,787.71
				205,013.96				205,013.96
					5,244.65		54,788.58	164,515.35
					143.87		77,509.84	102,589.66
					11,552.64		26,052.63	46,114.52
					3,719.58		3.35	27,738.06
					21,370.71		177,604.48	435,589.40
					43,260.43			47,661.69
					11,082.32		135,035.79	220,934.80
					240,250.54		1,455,862.60	1,990,075.39
					49.32			12,459.84
					3,920.41		48.90	91,845.03
					44.38		0.12	13,251.05
					5,434.56		3.73	41,682.73
					16,999.41		793,328.91	1,295,210.90
					214,391.16		2.17	488,110.81
					5,261.11		77.92	64,902.44
							0.19	28,433.13
					216,578.02			235,529.11
					206,287.15		75,971.63	737,237.29
					34,480.54		230,627.64	671,616.51
							98.78	50,707.27
							2.30	24,788.24
							5.84	73,010.94
								214,752.19
							184,007.00	1,040,070.79
113,368.38	3,514.05	929.48	6,981.54	2,523.77				870,116.71
24,613.34	8,839.92	16,412.38	45,241.69	7,214.47				3,224,041.32
671,616.51	50,707.27	24,788.24	73,010.94	214,752.19	1,040,070.79	870,116.71	3,224,041.32	

Appendix 7.1 Base Year Value Share of Production Inputs of the Berau District

Activities / Inputs	FCRO (1)	OILP (2)	OESC (3)	LIVS (4)	TIMB (5)	OFOP (6)	FISH (7)	COAL (8)	QUAR (9)	FBIN (10)	TEXL (11)	FOIN (12)	PAPR (13)	OILR (14)	FERC (15)	ELWT (16)	CONS (17)	TRAD (18)	TRAN (19)	COMM (20)	FINA (21)	SERV (22)	PUBO (23)
Factors of Production																							
- Labour	**0.50**	**0.39**	**0.49**	**0.44**	**0.49**	**0.56**	**0.49**	**0.44**	**0.49**	**0.09**	**0.20**	**0.19**	**0.25**	**0.11**	**0.15**	**0.22**	**0.12**	**0.42**	**0.29**	**0.42**	**0.41**	**0.46**	**0.81**
- LAP	0.09	0.16	0.18	0.18	0.19	0.21	0.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- LANP	0.40	0.19	0.22	0.22	0.19	0.23	0.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- LNAP	0.00	0.04	0.07	0.04	0.09	0.09	0.02	0.44	0.22	0.06	0.16	0.11	0.20	0.09	0.11	0.22	0.09	0.16	0.16	0.33	0.41	0.33	0.73
- LNANP	0.00	0.00	0.02	0.00	0.03	0.03	0.01	-	0.26	0.03	0.04	0.08	0.05	0.02	0.03	0.01	0.03	0.26	0.12	0.09	0.01	0.12	0.08
Capital	**0.35**	**0.20**	**0.26**	**0.19**	**0.37**	**0.30**	**0.33**	**0.35**	**0.22**	**0.04**	**0.10**	**0.11**	**0.17**	**0.06**	**0.06**	**0.12**	**0.05**	**0.29**	**0.15**	**0.31**	**0.20**	**0.31**	**0.15**
Land factors	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total Intermediate	**0.15**	**0.41**	**0.25**	**0.37**	**0.13**	**0.13**	**0.18**	**0.22**	**0.29**	**0.87**	**0.70**	**0.70**	**0.57**	**0.83**	**0.79**	**0.66**	**0.82**	**0.29**	**0.56**	**0.27**	**0.38**	**0.23**	**0.05**
FCRO	0.06	-	-	0.01	0.00	-	0.00	-	-	0.31	-	-	-	0.00	0.00	-	-	0.01	0.02	-	-	-	0.00
OILP	-	0.24	-	-	-	-	-	-	-	0.30	-	-	-	-	-	-	-	-	-	-	-	-	-
OESC	-	-	0.06	0.00	-	-	-	-	-	0.01	0.01	0.00	0.00	0.13	0.00	-	-	0.00	0.00	-	-	-	0.00
LIVS	0.00	0.00	0.00	0.02	-	-	0.00	-	-	0.02	0.01	-	-	0.04	0.00	-	-	0.00	0.00	-	-	-	0.00
TIMB	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.27**	**0.18**	**0.00**	**0.00**	**-**	**0.07**	**0.00**	**0.00**	**-**	**-**	**-**	**0.00**
OFOP	-	-	-	-	0.00	0.00	0.00	-	-	0.00	0.00	0.00	0.00	0.02	0.00	-	0.00	0.00	-	-	-	-	0.00
FISH	0.00	0.00	0.00	-	-	-	0.04	-	-	0.03	0.00	0.02	-	0.04	0.00	-	-	0.01	0.01	-	-	0.00	0.00
COAL	-	-	-	-	-	-	-	0.17	-	-	-	-	-	0.05	0.39	0.15	-	-	-	-	-	-	-
QUAR	-	-	-	-	-	-	-	-	0.00	-	-	-	0.00	0.00	0.00	-	0.06	-	-	-	-	-	-
FBIN	0.00	-	0.00	0.25	-	-	0.02	-	-	0.07	0.02	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00
TEXL	0.00	0.00	0.00	-	0.00	0.00	0.01	0.00	0.00	0.00	0.21	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FOIN	0.00	-	0.00	0.00	-	-	0.00	-	0.00	0.00	0.01	0.11	0.00	0.01	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00
PAPR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.30	0.02	0.01	0.00	0.00	0.07	0.00	0.01	0.01	0.01	0.00
OILR	0.00	0.02	0.00	0.00	0.03	0.01	0.05	0.00	0.07	0.01	0.06	0.04	0.00	0.17	0.04	0.29	0.30	0.02	0.16	0.03	0.01	0.03	0.01
FERC	0.05	0.06	0.08	0.01	0.00	0.00	0.00	0.00	0.03	0.01	0.06	0.05	0.00	0.01	0.23	0.01	0.04	0.01	0.00	0.00	0.00	0.00	0.00
ELWT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.01	0.01	0.08	0.00	0.01	0.00	0.01	0.01	0.00	0.00
CONS	0.00	0.03	0.04	0.00	0.02	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.01	0.07	0.00
TRAD	0.01	0.01	0.02	0.05	0.02	0.01	0.04	0.01	0.04	0.07	0.08	0.10	0.06	0.15	0.04	0.05	0.16	0.05	0.14	0.01	0.01	0.02	0.01
TRAN	0.00	0.01	0.02	0.01	0.02	0.01	0.01	0.03	0.05	0.02	0.11	0.07	0.02	0.08	0.04	0.01	0.05	0.07	0.19	0.05	0.03	0.02	0.00
COMM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.05	0.04	0.01	0.00
FINA	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.04	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.12	0.03	0.00
SERV	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.02	0.00	0.02	0.01	0.00	0.01	0.01	0.04	0.05	0.03	0.00	0.05	0.13	0.03	0.00
PUBO	0.00	0.02	0.00	0.00	0.00	0.05	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.01	0.00
TOT	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Source: Social Accounting Matrix of the Berau District, 2007

Appendix 7.2 Base Year Value Share of Primary Inputs

Activities	Share of Primary Inputs (%)							Total	Lab/Cap Ratio
	- Labour	- LAP	- LANP	- LNAP	- LNANP	Capital	Land		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Agriculture	**63.06**	**23.08**	**31.82**	**6.54**	**1.62**	**36.69**	**0.25**	**100.00**	**1.76**
FCRO	58.39	10.42	47.40	0.12	0.45	41.33	0.28	100.00	1.41
OILP	66.12	26.83	32.67	6.22	0.40	33.65	0.23	100.00	1.97
OESC	65.62	24.20	29.86	8.79	2.77	34.14	0.24	100.00	1.92
LIVS	70.10	28.28	35.02	6.38	0.41	29.69	0.21	100.00	2.36
TIMB	56.89	21.40	21.61	10.71	3.17	42.83	0.28	100.00	1.33
OFOP	64.83	24.24	26.67	10.53	3.39	34.93	0.24	100.00	1.86
FISH	59.45	26.16	29.52	3.05	0.73	40.27	0.28	100.00	1.48
Manufacture	**64.67**	**-**	**-**	**47.20**	**17.47**	**35.33**	**-**	**100.00**	**1.88**
COAL	55.65	-	-	55.65	-	44.35	-	100.00	1.25
QUAR	68.79	-	-	31.55	37.24	31.21	-	100.00	2.20
FBIN	66.23	-	-	47.39	18.84	33.77	-	100.00	1.96
TEXL	66.78	-	-	52.60	14.18	33.22	-	100.00	2.01
FOIN	64.48	-	-	37.09	27.38	35.52	-	100.00	1.82
PAPR	59.26	-	-	47.73	11.54	40.74	-	100.00	1.45
OILR	65.16	-	-	51.52	13.64	34.84	-	100.00	1.87
FERC	71.04	-	-	54.08	16.97	28.96	-	100.00	2.45
Serv	**66.01**	**-**	**-**	**50.81**	**15.20**	**33.99**	**-**	**100.00**	**2.23**
ELWT	64.52	-	-	62.79	1.73	35.48	-	100.00	1.82
CONS	69.40	-	-	52.97	16.43	30.60	-	100.00	2.27
TRAD	59.43	-	-	22.62	36.80	40.57	-	100.00	1.46
TRAN	65.57	-	-	37.06	28.51	34.43	-	100.00	1.90
COMM	57.57	-	-	45.04	12.53	42.43	-	100.00	1.36
FINA	67.36	-	-	65.89	1.47	32.64	-	100.00	2.06
SERV	59.62	-	-	43.51	16.11	40.38	-	100.00	1.48
PUBO	84.62	-	-	76.64	7.98	15.38	-	100.00	5.50

Source: Social Accounting Matrix of the Berau District, 2007

Appendix 7.3 Base Year Value Share of Sectoral Composition

Commodities	Sectoral Composition (%)					Ratio (%)	
	GRP	Output	Domestic Supply	Exports	Imports	Exports/ Output	Imports/ Commposite Supply
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FCRO	3.02	2.62	2.71	1.81	1.50	38.66	11.08
OILP	1.47	1.76	0.62	2.56	-	81.66	-
OESC	0.63	0.61	0.50	0.86	1.31	79.53	52.87
LIVS	0.32	0.38	0.68	0.00	0.78	0.02	22.64
TIMB	8.62	6.75	6.37	5.87	1.65	48.74	5.18
OFOP	0.96	0.82	1.18	-	0.04	-	0.65
FISH	4.18	3.66	2.12	4.46	0.44	68.27	4.11
COAL	37.54	30.56	13.18	48.10	0.03	88.22	0.04
QUAR	0.18	0.16	0.31	-	0.26	-	16.75
FBIN	0.03	0.15	2.27	0.00	10.33	0.62	91.01
TEXL	0.01	0.03	0.33	0.00	1.41	0.01	86.00
FOIN	0.14	0.33	1.03	0.00	2.87	0.02	55.71
PAPR	14.49	21.39	12.39	26.21	0.27	68.69	0.43
OILR	0.06	0.21	12.05	0.00	58.90	0.02	97.60
FERC	0.07	0.16	1.60	0.00	6.79	0.88	84.70
ELWT	0.20	0.45	0.70	0.00	0.48	0.00	13.65
CONS	1.21	4.13	5.81	-	-	-	-
TRAD	12.95	10.92	16.32	2.51	0.31	12.88	0.37
TRAN	7.99	9.88	10.88	7.62	3.04	43.22	5.58
COMM	0.73	0.71	1.25	0.00	1.09	0.26	17.47
FINA	0.13	0.14	0.61	0.00	2.03	0.03	66.22
SERV	0.53	0.38	1.80	0.00	5.59	0.03	61.97
PUBO	4.56	3.80	5.30	-	0.89	-	3.36
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**56.06**	**19.96**

Source: Social Accounting Matrix of the Berau District, 2007

Appendix 7.4 Base Year Value Share of Domestic Usage (Absorption)

Commodity	Share of domestic absorption				Total
	Intermediate	Household	Government	Investment	
	(1)	(2)	(3)	(4)	(5)
FCRO	25.09	67.31	2.83	4.78	100.00
OILP	99.43	-	-	0.57	100.00
OESC	22.65	19.73	0.04	57.58	100.00
LIVS	19.66	66.93	-	13.41	100.00
TIMB	91.72	-	-	8.28	100.00
OFOP	4.78	4.45	-	90.77	100.00
FISH	17.22	69.74	0.15	12.90	100.00
COAL	55.03	-	-	44.97	100.00
QUAR	99.60	-	-	0.40	100.00
FBIN	27.88	67.42	0.43	4.27	100.00
TEXL	21.44	78.12	0.10	0.33	100.00
FOIN	57.27	28.01	1.68	13.04	100.00
PAPR	77.90	6.26	12.45	3.39	100.00
OILR	42.06	13.33	0.69	43.92	100.00
FERC	61.16	29.36	1.36	8.12	100.00
ELWT	43.60	44.33	12.06	-	100.00
CONS	8.04	-	0.01	91.95	100.00
TRAD	37.93	25.71	5.16	31.20	100.00
TRAN	54.52	26.14	11.52	7.82	100.00
COMM	32.48	38.43	29.09	-	100.00
FINA	56.39	41.41	2.20	-	100.00
SERV	62.02	36.57	1.41	-	100.00

Source: Social Accounting Matrix of the Berau District, 2007

Appendix 8.1 Low Risk's Approval Letter received from Human Ethics Committee of University of Canterbury

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2011/01/LR-PS

20 February 2012

Kadim Martana
School of Forestry
UNIVERSITY OF CANTERBURY

Dear Kadim

Thank you for forwarding to the Human Ethics Committee a copy of the low risk application you have recently made for your research proposal "Modelling socio-economic impacts of policy to reduce emissions from deforestation and forest degradation: a Berau District, East Kalimantan Province, Indonesia case study".

I am pleased to advise that this application has been reviewed and I confirm support of the Department's approval for this project.

This approval is subject to the following:

- The consent form, please remove the reference to data being destroyed after five years and replace with data being kept and then destroyed after 10 years.

With best wishes for your project.

Yours sincerely

Michael Grimshaw
Chair
University of Canterbury Human Ethics Committee

University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand. www.canterbury.ac.nz

E S

Appendix 8.2 Application for Low Risk Research as Part of the study

PhD and STAFF RESEARCH

ETHICAL APPROVAL OF LOW RISK RESEARCH INVOLVING HUMAN PARTICIPANTS REVIEWED BY DEPARTMENTS

..1.1.1. PLEASE read the important notes appended to this form before completing the sections below

1 **RESEARCHER'S NAME:** Kadim Martana

2 **NAME OF DEPARTMENT OR SCHOOL:** School of Forestry, University of Canterbury

3 **EMAIL ADDRESS:** kadimmartana@pg.canterbury.ac.nz, kma80@uclive.ac.nz

4 **TITLE OF PROJECT**: Modelling Socio-Economic Impacts of Policy to Reduce Emissions from Deforestation and Forest Degradation: a Berau District, East Kalimantan Province - Indonesia Case Study

5 **PROJECTED START DATE OF PROJECT:** 20 February 2012

6 **STAFF MEMBER/SUPERVISOR RESPONSIBLE FOR PROJECT:**
Dr. David Evison and Dr. Bruce Manley (School of Forestry UC), and Dr. James Lennox (Landcare Research of NZ)

7 **NAMES OF OTHER PARTICIPATING STAFF AND STUDENTS:**

8 **STATUS OF RESEARCH**: (pilot study, thesis, staff research – please include status of student researchers involved if this is a staff-led project)
- Part of PhD thesis

9 **BRIEF DESCRIPTION OF THE PROJECT:**
Please give a brief summary (approx. 500 words) of the nature of the proposal in lay language, including the aims/objectives/hypotheses of the project, rationale, participant description, and procedures/methods of the project:-

The Government of Indonesia is commited to reducing emissions from deforestation and forest degradation (REDD). Among several demonstration activities of REDD Program being set up in Indonesia is the Berau Forest Carbon Program (BFCP). The program, which was initiated by the Nature Conservation Indonesia and the Government of Indonesia, involves many forest related stakeholders including (but not limited to) forest-dependent community, forestry/logging company and Oil Palm Plantation Company. In general, the REDD program in Indonesia and particulalry the BFCP attempt to adverse those forest stakeholders' behaviour from business as usual activity to fewer producing-emissions activity. For example, the BFCP program attract forest concession holders to engage in reduced-impact logging and forest certification program, which are considered as to produce less emissions compared to their business as usual activity. Other critical stakeholders targeted by the REDD/BFCP program are forest-dependent community and oil-palm plantation Company.

This proposal is part of my PhD research on modelling the economic impacts of the policy to reduce emissions from deforestation and forest degradation (known as REDD) in Indonesia, taking a case study of the Berau District, the East Kalimantan Province, Indonesia, by utilising an economic approach of the computable general equilibrium (CGE) model.

This research's objectives is twofold i.e. to obtain experts' estimate on the responses of specific forest-stakeholders to policy to reduce emissions from deforestation and forest degradation and to generate CGE model inputs based on the predicted responses. Three expert groups of whose knowledge and expertise relevant to each type of forest-stakeholders will be interviewed. The experts may include pertinent national and local policy makers, NGOs, researchers as well as academic resources whose knowledge and experience are relevant to the three forest stakeholders. The questionnaire is formulated in a semi structured interview type in accordance to the project objective. The questionnaire is also provided in 'bahasa Indonesia' to make the respondent more convenient to answer.

Experts are identified and sought in several ways such as from institutional address directory, official web site and other personal recommendation. For questionnaire No. 2 and No. 3, I mostly use drop and pick up technique. Meanwhile, for questionnaire no. 1, direct interview is used. For some specific cases where resources are unable to be interviewed directly, phone interview will be utilised.

It is important to note that the questionnaires have not been pilot tested. Hence they are subject to revision following inputs from the pilot testing (e.g. to improve clarity of questions).

10 WHY IS THIS A LOW RISK APPLICATION?

Description should include issues raised in the Low Risk Checklist

Please give details of any ethical issues which were identified during the consideration of the proposal and the way in which these issues were dealt with or resolved.

This research attempts to solicit experts' opinion in the process of policy formulation to reduce emissions from deforestation and forest degradation. The questionnaire asked is formulated in a transparent manner. The process and questions formulated does not contain any questions that reflect threats, invasion of privacy and will not induce in any physical and cultural risk or stress. In addition, the does not collect any personal information of a sensitive nature about or from individuals.

11 PROVIDE COPIES OF INFORMATION & CONSENT FORMS FOR PARTICIPANTS

These forms should be on University of Canterbury Departmental letterhead. The name of the project, name(s) of researcher(s), contact details of researchers (and for PhD students, the supervisor), names of who has access to the data, the length of time the data is to be stored, that participants have the right to withdraw participation and data provided, and what the data will be used for should all be clearly stated. A statement that the project has been reviewed approved by the appropriate department and the UCHEC Low Risk Approval process should also be included.

Please ensure that Section A (where appropriate), B and C below are all completed

APPLICANT'S SIGNATURE: .... **Date** ....

A SUPERVISOR DECLARATION for PhD research:

1 I have made the applicant fully aware of the need for and the requirement of seeking HEC approval for research involving human participants.
2 I have ensured the applicant is conversant with the procedures involved in making such an application.
3 In addition to this form the applicant has individually filled in the full application form which has been reviewed by me.

SIGNED (Supervisor): .... **Date** ....

B THIS RESEARCH IS SUPPORTED BY THE DEPARTMENTAL/SCHOOL RESEARCH COMMITTEE:

Name .... **Signature:** ....

Date ....

C APPROVED BY HEAD OF DEPARTMENT/SCHOOL:

Name .... **Signature:** ....

Date ....

NOTE ON PROCEDURE:

THE UC HEC CHAIR AND TWO OTHER MEMBERS OF THE UC HEC WILL REVIEW THIS APPLICATION.

ACTION TAKEN BY HUMAN ETHICS COMMITTEE:

☐ Added to PhD & Staff Low Risk Reporting Database ☐ Referred to University of Canterbury HEC

☐ Referred to another Ethics Committee - Please specify:

....

REVIEWED BY: .... (HEC CHAIR)

: ....

: ....

Date ....

Please attach copies of any Information Sheet and Consent Form
Forward two copies to:
The Secretary
Human Ethics Committee
Level 6, Registry Building

All queries will be forwarded to the applicant within 7 days
If a PhD student, please include a copy of this form as an appendix in your thesis

NOTES CONCERNING LOW RISK REPORTING SHEETS

1. **This form should only be used for proposals which are Low Risk** as defined in the University of Canterbury Human Ethics Committee Principles and Guidelines policy document, and which may therefore be properly considered and approved at departmental level under Section 5 of that document;

2. Low Risk applications are:

   PhD thesis, pilot studies and staff research where the projects do not raise any issue of deception, threat, invasion of privacy, mental, physical or cultural risk or stress, and do not involve gathering personal information of a sensitive nature about or from individuals.

3. No research can be counted as low risk if it involves:

   (i) invasive physical procedures or potential for physical harm
   (ii) procedures which might cause mental/emotional stress or distress, moral or cultural offence
   (iii) personal or sensitive issues
   (iv) vulnerable groups
   (v) Tangata Whenua
   (vi) cross cultural research
   (vii) investigation of illegal behaviour(s)
   (viii) invasion of privacy
   (ix) collection of information that might be disadvantageous to the participant
   (x) use of information already collected that is not in the public arena which might be disadvantageous to the participant
   (xi) use of information already collected which was collected under agreement of confidentiality
   (xii) participants who are unable to give informed consent
   (xiii) conflict of interest e.g. the researcher is also the lecturer, teacher, treatment-provider, colleague or employer of the research participants, or there is any other power relationship between the researcher and the research participants.
   (xiv) deception
   (xv) audio or visual recording without consent
   (xvi) withholding benefits from "control" groups
   (xvii) inducements
   (xviii) risks to the researcher

   This list is not definitive but is intended to sensitise the researcher to the types of issues to be considered. Low risk research would involve the same risk as might be encountered in normal daily life.

4. **Responsibility**

   Supervisors are responsible for:

Theses where the projects do not raise any issues listed below.

   HODs are responsible for:
   (i) Giving final approval for the low risk application.
   (ii) Ensuring a copy of all applications are kept on file in the Department/School.

   NOTE: If the HOD is the applicant, then a senior member of staff and preferably also the department and/or school research committee should give final approval. The HOD is still responsible for (ii) above.

4. A separate low risk form should be completed for each research proposal involving human participants and for which ethical approval has been considered or given at Departmental level.

5. The completed form, **together with a copy of any Information Sheet or Consent Form**, should be returned to the Secretary, Human Ethics Committee, Level 6 Registry, **as soon as the proposal has been considered at departmental level**. *Please also submit an electronic version to the HEC secretary.*

6. The Information Sheet and Consent Form SHOULD NOT include the statement "This proposal has been reviewed and approved by the University of Canterbury Human Ethics Committee" as this is inappropriate for low risk proposals.

   However, DO INCLUDE a statement that the project has been reviewed and approved by the appropriate department and the UC HEC Low Risk Approval process.

7. Please ensure the Consent Form and the Information Sheet has been carefully proofread; the institution as a whole is likely to be judged by them.

8. A Low Risk proposal may commence within 7 days of lodging the low risk application. No correspondence will be received back from the University of Canterbury Human Ethics Committee (UC HEC) concerning this Reporting Sheet **unless the Committee has concerns or would like clarification of any aspect of the proposal.**

9. The research must be consistent with the UC HEC Principles and Guidelines. Refer to the appendices of the UC HEC Principles and Guidelines for guidance on information sheets and consent forms.

10. Please note that if the nature, procedures, location or personnel of the research project changes after departmental approval has been given in such a way that the research no longer meets the conditions laid out in Section 5 of the Principles and Guidelines, a full application to the HEC must be submitted.

11. This form is available electronically at the following web address: http://www.canterbury.ac.nz/humanethics

CHECKLIST

Please check that your application / summary has discussed:

- procedures for voluntary, informed consent
- privacy & confidentiality
- risk to participants
- obligations under the Treaty of Waitangi
- needs of dependent persons
- conflict of interest
- permission for access to participants from other individuals or bodies
- inducements

In some circumstances research which appears to meet low risk criteria may need to be reviewed by the UC HEC. This might be because of requirements of:

- The publisher of the research
- An organisation which is providing funding resources, existing data, access to participants etc.

Research which meets the criteria for review by a Health and Disability Ethics Committee – please see the HEC web site

The Human Ethics Committee is happy to give advice on the appropriateness of research for low risk review.
Please contact the UC HEC Chair.

Appendix 8.3 Participants Information & Questionnaire Sheets

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Participants Information Sheets

(Method of interview: semi structured interview)

Title: **Experts' Opinion on the Responses of Forest-Stakeholders to Policy to Reduce Emissions from Deforestation and Forest Degradation in Indonesia**

(Part of Research on Modelling Socio-Economic Impacts of Policy to Reduce Emissions from Deforestation and Forest Degradation: a Berau District - Indonesia Case Study)

The Government of Indonesia is commited to reducing emissions from deforestation and forest degradation (REDD). Among several demonstration activities of REDD Program being set up in Indonesia is the Berau Forest Carbon Program (BFCP). The program, which was initiated by the Nature Conservation Indonesia and the Government of Indonesia, involves many forest related stakeholders including (but not limited to) forest-dependent community, forestry/logging company and Oil Palm Plantation Company. In general, the REDD program in Indonesia and particulalry the BFCP attempt to adverse those forest stakeholders' behaviour from business as usual activity to fewer producing-emissions activity. For example, the BFCP program attract forest concession holders to engage in reduced-impact logging and forest certification program, which are considered as to produce less emissions compared to their business as usual activity. Other critical stakeholders targeted by the REDD/BFCP program are forest-dependent community and oil-palm plantation Company.

This proposal is part of my PhD research on modelling the economic impacts of the policy to reduce emissions from deforestation and forest degradation (known as REDD) in Indonesia, taking a case study of the Berau District, the East Kalimantan Province, Indonesia, by utilising an economic approach of the computable general equilibrium (CGE) model.

This research's objectives is twofold i.e. to obtain experts' estimate on the responses of specific forest-stakeholders to policy to reduce emissions from deforestation and forest degradation and to generate CGE model inputs based on the predicted responses. Three expert groups of whose knowledge and expertise relevant to each type of forest-stakeholders will be interviewed.

I am interested in your knowledge, expertise and experience to assess how a particular forest-stakeholder (relevant to your expertise) will respond to a pertinent policy to REDD. You will be asked some questions and the degree of confident of your opinion. The interview may take up to 45 minutes to complete.

I would like to assure you of my respect for privacy and personal security. In this research, confidentiality is guaranteed, your name will be known during the survey but the identifying information given is not going to be passed on or known to another person or used by others except me and my supervisors. Your name will not appear in all publications of the results. You may withdraw your participation from the research at any time or refuse to answer any questions that make you uncomfortable.

It is important to note that a PhD is a public document via University of Canterbury library database and this project has been reviewed and approved by the University of Canterbury Human Ethic Committee PhD & Staff low risk process.

I really appreciate for your time in helping me with this study.

Any inquiries related to this project can be addressed to the followings:

Kadim Martana

(Student)

kadim.martana@pg.canterbury.ac.nz

Phone:

+64 22 0356455 (New Zealand), +62 853 1018 4657 (Indonesia)

Address:

School of Forestry, University of Canterbury,

Forestry Road, Christchurch, New Zealand

Tel. +64 3 364 2109, Fax: +64 3 364 2124

Dr. David Evison

(Principal Supervisor)

Address:

Email: david.evison@canterbury.ac.nz

School of Forestry, University of Canterbury,

Forestry Road, Christchurch, New Zealand

Tel. +64 3 364 2109, Fax: +64 3 364 2124

SURVEY QUESTIONNAIRE

This questionnaire is designed to elicit your opinion in estimating forestry/logging company (*HPH*)'s response to the application of Reduced-Impact Logging (RIL) technique and forest certification as a policy measure to reducing emissions from deforestation and forest degradation in the production forest. Your opinion will be used for academic purposes only and highly appreciated.

Expert background information

Please describe the following aspects of your work. The information provided will be used to compile a summary description of the sources/experts interviewed in this study. This summary will be included in the report of the study.

No	Question	Answers
1	Name	....
2	Institutional affiliation	.... e.g. the MoForestry, NGO ..etc.
3	Current research interests and specialty areas	... e.g.
	How long have you been in this specialty areas?	... years
4	Your advanced education by discipline	...
5	How do you define your current discipline	... e.g. forester, anthropologist, etc.

Brief background of the questions

Reduced-Impact Logging (RIL) technique is defined as 'a systematic approach to planning, implementing, monitoring, and evaluating logging'. It embraces 'a host of improved road building, felling and skidding practices'. Therefore, the RIL demands 'forethought and skill, and policy environment that encourages them' (Elias et al., 2001). In addition, successful implementation of RIL technique requires (Dykstra, 2001; Bull et al, 2001):

- Pre-harvest activities including careful inventory & mapping of individual trees, road planning, skid trail, tree fell direction, climber cutting, road construction, landing and skid trail that adhere environmental guideline;
- careful harvest /logging activities including use of appropriate felling and bucking technique, follow directional felling; minimise skid trail length; suspend logs above the ground if possible to minimise soil disturbance;
- Post-harvest activities including e.g. evaluate the degree of RILL application and feedback to concession holder.

Further than that RIL/ imporvement of forest management is considered as pre-requisite for obtaining forest certification. Currently, the government of Indonesia introduced e new system called Timber Legality Verfication System (*Sistem Verfikasi Legalitas Kayu*/SVLK) to ensure that timber and timber product traded in Indonesia is legal (harvested from legal sources). The system is the government's follow up of the Forest Law Enforcement, Governance and Trade (FLEGT) Program, which was introduced by European Union in 2005) and Voluntary Partnership Agreement (VPA) between the EU and indonesia. The

SLVK contains indicators which are comparable with ones of Sustainable Forest, hence the *SLVK* represents strong base for forest certification (LEI and DfID, no year).
Consider the REDD policy of the government of Indonesia, and the demonstration activity of the BFCP program in particular in which forestry company or forest concessions holders (HPH) are asked to participate into the programme to reduce emissions from deforestation and forest degradation (REDD) trough applying reduced-impact logging (RIL) technique and forest certification (SLVK/FSC).
As an expert, you are asked to estimate the forest company's response on these policy measures by answering these questions:

No		**Question**	**Answers**		
			*Min. estimate *)*	*Average*	*Max. estimate*
			*High **)*	*Medium*	*Low*
		Regarding RIL technique			
1	a.	How much do you think the RIL will **increase** a logging company's production cost?	...US$/ha	1	a.
		(or percentage term)	…%		
	b.	How do you describe your confident in judging this?			b.
2	a.	How much do you think the RIL will **increase** a logging company's output?	…m3/ha	2	a.
		(or percentage term)	…%		
	b.	How do you describe your confident in judging this?			b.
		Regarding the *SVLK*			
1	a.	How much do you think the *SVLK* will **increase** a logging company's production cost?	...US$/ha	1	a.
		(or percentage term)	…%		
	b.	How do you describe your confident in judging this?			b.
2	a.	How much do you think the SVLK will **increase** a logging company's output?	…m3/ha	2	a.
		(or percentage term)	…%		
	b.	How do you describe your confident in judging this?			b.
		Regarding Forest Certification			
1	a.	How much do you think the *forest certification* will **increase** a logging company's production cost?	...US$/ha	1	a.
		(or percentage term)	…%		
	b.	How do you describe your confident in judging this?			b.
2	a.	How much do you think that by applying forest certification, the company will increase production price	…US$ / m3	2	a.

		(or in percentage term)	…%		
	b.	How do you describe your confident in judging this?			b.
		Rewarding the company that maintain the RIL/SVLK/Forest Certification			
1	a	How much do you think *an annual incentive per ha per year* should be provided to logging company to maintain *the RIL*?	...US$/ha	1	a
	b	How do you describe your confident in judging this?			b
2	a	How much do you think *an annual incentive per ha per year* should be provided to logging company to maintain *the forest certification*?	...US$/ha	2	a
	b	How do you describe your confident in judging this?			b

Note:

*) : to answer question a. can be answered in a range of value of single point.

**) : to answer question b; which has three answer a) High refers to high confident meaning that 'you are very sure of your knowledge and opinions concerning this item are correct and valuable'; b) Medium refers medium confidence meaning 'you are somewhat sure of your knowledge and and opinions concerning this item'; and c) Low refers to low confidence meaning 'you are not at all sure of your knowledge and and opinions concerning this item'.

Appendix 8.4 Participant Consent's Form – English and Indonesian Versions

Title: **Experts' Opinion on the Responses of Forest-Stakeholders to Policy to Reduce Emissions from Deforestation and Forest Degradation in Indonesia**

(Part of Research on Modelling Socio-Economic Impacts of Policy to Reduce Emissions from Deforestation and Forest Degradation: a Berau District - Indonesia Case Study)

Consent Form for Participants

I have been given a full explanation of this project and have been given an opportunity to ask questions.

I understand what will be required of me if I agree to take part in this project.

I understand that my participation is voluntary and that I may withdraw at any stage without penalty.

I understand that any information or opinions I provide will be kept confidential to the researcher and that any published or reported results will not identify me.

I understand that all data collected for this study will be kept in locked and secure facilities at the

University of Canterbury and will be destroyed after five years.

I understand that I will receive a report on the findings of this study. I have provided my email/contacts details below for this.

I understand that if I require further information I can contact the researcher, Kadim Martana. If I have any complaints, I can contact Dr. David Evison at email david.evison@canterbury.ac.nz of the School of Forestry Canterbury, University of Canterbury,Forestry Road, Christchurch, New Zealand, Tel. +64 3 364 2109, Fax: +64 3 364 2124 University, or the Chair of the University of Canterbury Educational Research Human Ethics Committee.

By signing below, I agree to participate in this research project.

Name: ___________________________________

Date: ___________________________________

Signature: ___________________________________

Email address: ___________________________________

Please return this completed consent form to Kadim Martana, along with fulfilled questionnaire.

Lembar Informasi Peserta)

Judul: Opini para Ahli dalam hal Respon dari Stakeholder Kehutanan terhadap Kebijakan Pengurangan Emisi dari Deforestasi dan Degradasi Hutan di Indonesia

(Bagian dari penelitian Memodelkan Impak Sosial Ekonomi Kebijakan Pengurangan Emisi dari Deforestasi dan Degradasi Hutan: sebuah Study Kasus di Berau Forest Carbon Project (BFCP), Kalimantan Timur, Indonesia)

Lembar Persetujuan Peserta

Saya telah diberi penjelasan sepenuhnya akan kegiatan penelitian ini dan diberikan kesempatan bertanya mengenai proyek ini.

Saya mengerti sepenuhnya apa yang dibutuhkan dan saya menyetujui untuk ambil bagian dari kegiatan ini.

Saya mengerti bahwa partisipasi saya adalah bersifat sukarela dan saya diperbolehkan mengundurkan diri pada tahapan apapun tanpa mendapatkan penalty.

Saya mengerti bahwa informasi atau opini yang saya berikan akan dirahasiakan oleh peneilit dan publikasi apapun tidak akan mengidentifikasi diri saya.

Saya mengerti bahwa data yang dikumpukan untuk studi ini akan disimpan dalam fasilitas yang aman di Universitas Canterbury and dimusnahkan setelah lima tahun.

Saya mengerti bahwa saya bisa memperoleh informasi hasil atau temuan dari studi ini. Saya telah menyediakan detil email/kontak di bawah untuk kepentingan ini.

Saya mengerti bahwa jika saya membutuhkan informasi lebih jauh, saya bias menghubungi Kadim Martana. Jika saya memiliki keluhan, saya dapat menghubungi Dr. David Evison di email david.evison@canterbury.ac.nz atau di Sekolah Kehutanan, Universitas Canterbury, Forestry Road, Christchurch, New Zealand, Tel. +64 3 364 2109, Fax: +64 3 364.

Dengan menandatangani di bawah ini, saya setuju untuk berpartisipasi dalam penelitian ini.

Nama: ___________________________________

Tanggal: ___________________________________

Tanda tangan: ___________________________________

Alamat email: ___________________________________

Mohon lembar persetujuan ini dikembalikan kepada Kadim Martana, bersama dengan kuesioner yang telah diisi.

Appendix 9.1 Sectors' Output Level in Baseline Simulation, 2007 to 2025

Year	Sectors																						
	FCRO	OILP	OESC	LIVS	TIMB	OFOP	FISH	COAL	QUAR	FBIN	TEXL	FOIN	PAPR	OILR	FERC	ELWT	CONS	TRAD	TRAN	COMM	FINA	SERV	PUBO
2007	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2008	1.0851	1.1069	1.0938	1.0856	1.0827	1.0843	1.0871	1.0868	1.0847	1.0853	1.0843	1.0847	1.0819	1.0852	1.0875	1.0859	1.0846	1.0843	1.0868	1.0871	1.0873	1.0845	1.0964
2009	1.1548	1.1667	1.1595	1.1552	1.1533	1.1546	1.1557	1.1564	1.1548	1.1550	1.1545	1.1547	1.1529	1.1551	1.1563	1.1555	1.1547	1.1546	1.1561	1.1562	1.1562	1.1547	1.1613
2010	1.2430	1.2652	1.2519	1.2438	1.2403	1.2426	1.2447	1.2457	1.2430	1.2433	1.2424	1.2429	1.2396	1.2435	1.2458	1.2442	1.2428	1.2426	1.2453	1.2456	1.2456	1.2428	1.2551
2011	1.3303	1.3525	1.3392	1.3314	1.3276	1.3302	1.3319	1.3338	1.3307	1.3308	1.3299	1.3305	1.3271	1.3312	1.3334	1.3319	1.3305	1.3303	1.3331	1.3333	1.3332	1.3305	1.3429
2012	1.4238	1.4458	1.4327	1.4251	1.4209	1.4241	1.4252	1.4281	1.4245	1.4245	1.4236	1.4242	1.4206	1.4250	1.4271	1.4257	1.4243	1.4242	1.4270	1.4272	1.4269	1.4243	1.4368
2013	1.5237	1.5456	1.5326	1.5254	1.5208	1.5244	1.5249	1.5289	1.5249	1.5246	1.5237	1.5245	1.5206	1.5254	1.5274	1.5260	1.5247	1.5245	1.5275	1.5276	1.5271	1.5247	1.5372
2014	1.6307	1.6524	1.6395	1.6326	1.6276	1.6318	1.6316	1.6369	1.6323	1.6317	1.6309	1.6318	1.6276	1.6328	1.6347	1.6334	1.6321	1.6320	1.6351	1.6351	1.6344	1.6322	1.6447
2015	1.7450	1.7666	1.7538	1.7474	1.7418	1.7467	1.7457	1.7524	1.7472	1.7463	1.7456	1.7466	1.7421	1.7476	1.7494	1.7483	1.7470	1.7469	1.7501	1.7500	1.7492	1.7471	1.7597
2016	1.8673	1.8887	1.8761	1.8702	1.8640	1.8696	1.8677	1.8761	1.8702	1.8689	1.8682	1.8695	1.8645	1.8706	1.8722	1.8712	1.8699	1.8699	1.8733	1.8730	1.8719	1.8700	1.8827
2017	1.9982	2.0193	2.0069	2.0015	1.9946	2.0011	1.9982	2.0084	2.0017	2.0000	1.9994	2.0008	1.9955	2.0021	2.0036	2.0027	2.0014	2.0014	2.0050	2.0047	2.0033	2.0016	2.0144
2018	2.1381	2.1590	2.1468	2.1420	2.1343	2.1418	2.1377	2.1501	2.1424	2.1403	2.1398	2.1414	2.1356	2.1428	2.1441	2.1433	2.1421	2.1422	2.1459	2.1455	2.1438	2.1424	2.1552
2019	2.2878	2.3084	2.2964	2.2924	2.2837	2.2924	2.2869	2.3017	2.2930	2.2903	2.2899	2.2918	2.2854	2.2933	2.2944	2.2938	2.2926	2.2928	2.2968	2.2962	2.2941	2.2930	2.3059
2020	2.4478	2.4682	2.4564	2.4532	2.4435	2.4534	2.4465	2.4640	2.4540	2.4508	2.4505	2.4527	2.4457	2.4543	2.4552	2.4549	2.4537	2.4539	2.4581	2.4574	2.4549	2.4541	2.4672
2021	2.6190	2.6391	2.6276	2.6252	2.6144	2.6257	2.6171	2.6376	2.6264	2.6225	2.6223	2.6248	2.6171	2.6266	2.6273	2.6271	2.6260	2.6263	2.6308	2.6298	2.6270	2.6265	2.6397
2022	2.8021	2.8218	2.8106	2.8093	2.7972	2.8101	2.7995	2.8235	2.8107	2.8062	2.8061	2.8089	2.8004	2.8109	2.8113	2.8114	2.8103	2.8107	2.8155	2.8144	2.8110	2.8109	2.8244
2023	2.9979	3.0173	3.0064	3.0061	2.9926	3.0073	2.9946	3.0224	3.0080	3.0026	3.0027	3.0059	2.9965	3.0081	3.0082	3.0086	3.0075	3.0080	3.0132	3.0118	3.0079	3.0082	3.0219
2024	3.2074	3.2263	3.2158	3.2168	3.2016	3.2183	3.2033	3.2353	3.2190	3.2127	3.2129	3.2166	3.2062	3.2191	3.2188	3.2195	3.2185	3.2191	3.2247	3.2231	3.2185	3.2193	3.2332
2025	3.4313	3.4498	3.4397	3.4421	3.4251	3.4440	3.4263	3.4632	3.4448	3.4375	3.4379	3.4420	3.4306	3.4448	3.4442	3.4452	3.4442	3.4449	3.4510	3.4491	3.4438	3.4451	3.4594
Average							3.4369									3.4431							3.4478

Appendix 9.2 Impact of RIL Policy on Sector's Output, real term at 2007 prices

Sector	Output Value in 2025			Value difference from Base in 2025		Difference	% Change from Base in 2025		Difference
	Base	RIL0	RIL2	RIL0	RIL2	*(6) - (5)*	RIL0	RIL2	*(9) - (8)*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
FCRO	486,281.42	514,242.64	513,548.21	27961.22	27266.79	-694.42	5.75%	5.61%	-0.14%
OILP	327,438.93	502,291.96	492,439.75	174853.03	165000.82	-9852.21	53.40%	50.39%	-3.01%
OESC	112,684.14	138,610.31	137,303.19	25926.17	24619.05	-1307.12	23.01%	21.85%	-1.16%
LIVS	70,164.12	70,147.82	70,272.16	-16.31	108.04	124.34	-0.02%	0.15%	0.18%
TIMB	1,248,013.35	750,826.63	774,984.55	-497186.71	-473028.79	24157.92	-39.84%	-37.90%	1.94%
OFOP	152,759.29	149,530.23	150,328.62	-3229.06	-2430.66	798.39	-2.11%	-1.59%	0.52%
FISH	677,720.48	807,892.35	801,859.46	130171.86	124138.98	-6032.89	19.21%	18.32%	-0.89%
COAL	5,715,450.61	6,235,802.18	6,176,390.01	520351.58	460939.41	-59412.17	9.10%	8.06%	-1.04%
QUAR	29,990.44	29,461.11	29,583.87	-529.32	-406.57	122.75	-1.76%	-1.36%	0.41%
FBIN	27,047.42	27,862.58	27,849.21	815.16	801.78	-13.38	3.01%	2.96%	-0.05%
TEXL	6,215.40	6,237.63	6,237.27	22.24	21.88	-0.36	0.36%	0.35%	-0.01%
FOIN	60,834.77	58,639.63	59,033.76	-2195.14	-1801.01	394.14	-3.61%	-2.96%	0.65%
PAPR	3,962,401.50	3,335,804.75	3,447,494.90	-626596.75	-514906.60	111690.15	-15.81%	-12.99%	2.82%
OILR	38,536.69	38,290.57	38,384.54	-246.11	-152.14	93.97	-0.64%	-0.39%	0.24%
FERC	30,631.30	32,045.38	32,029.37	1414.08	1398.07	-16.01	4.62%	4.56%	-0.05%
ELWT	83,454.18	81,237.75	81,501.78	-2216.43	-1952.40	264.03	-2.66%	-2.34%	0.32%
CONS	767,263.46	751,803.24	755,189.34	-15460.22	-12074.12	3386.10	-2.01%	-1.57%	0.44%
TRAD	2,031,533.83	1,991,786.56	2,000,396.50	-39747.27	-31137.33	8609.94	-1.96%	-1.53%	0.42%
TRAN	1,841,573.65	1,864,199.76	1,862,332.04	22626.11	20758.39	-1867.72	1.23%	1.13%	-0.10%
COMM	132,284.39	131,037.90	131,252.68	-1246.48	-1031.70	214.78	-0.94%	-0.78%	0.16%
FINA	25,643.85	25,404.07	25,456.94	-239.77	-186.90	52.87	-0.94%	-0.73%	0.21%
SERV	71,615.75	69,146.17	69,349.89	-2469.58	-2265.86	203.72	-3.45%	-3.16%	0.28%
PUBO	709,225.29	708,794.76	708,487.24	-430.53	-738.05	-307.52	-0.06%	-0.10%	-0.04%

Note: Figures are in IDR million (where applicable).

Appendix 9.3 Impact of RIL Policy on Sectoral Composite Commodity Supply, real term at 2007 prices

Sector	Composite Commodity Value in 2025			Value difference from Base in 2025		Difference	% Change from Base in 2025		Difference
	Base	RIL0	RIL2	RIL0	RIL2	(6) - (5)	RIL0	RIL2	(9) - (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FCRO	376,889.52	381,092.05	381,432.21	4,202.54	4,542.69	340.15	1.12%	1.21%	0.09%
OILP	86,492.76	128,398.62	126,026.07	41,905.86	39,533.31	-2,372.55	48.45%	45.71%	-2.74%
OESC	69,061.06	69,592.70	69,785.29	531.64	724.23	192.59	0.77%	1.05%	0.28%
LIVS	95,451.77	94,666.87	94,877.66	-784.89	-574.11	210.78	-0.82%	-0.60%	0.22%
TIMB	885,584.83	760,720.13	782,184.47	-124,864.70	-103,400.36	21,464.35	-14.10%	-11.68%	2.42%
OFOP	164,146.86	160,624.67	161,492.11	-3,522.20	-2,654.76	867.44	-2.15%	-1.62%	0.53%
FISH	295,002.99	314,381.81	313,900.77	19,378.82	18,897.78	-481.03	6.57%	6.41%	-0.16%
COAL	1,845,491.49	1,920,868.91	1,914,404.94	75,377.42	68,913.45	-6,463.97	4.08%	3.73%	-0.35%
QUAR	42,914.17	42,049.45	42,241.34	-864.71	-672.83	191.88	-2.01%	-1.57%	0.45%
FBIN	315,613.48	307,966.87	308,765.49	-7,646.62	-6,847.99	798.63	-2.42%	-2.17%	0.25%
TEXL	45,511.65	44,894.16	44,976.31	-617.49	-535.34	82.16	-1.36%	-1.18%	0.18%
FOIN	143,500.80	139,624.65	140,274.85	-3,876.15	-3,225.95	650.19	-2.70%	-2.25%	0.45%
PAPR	1,724,315.96	1,517,691.14	1,554,780.22	-206,624.82	-169,535.74	37,089.08	-11.98%	-9.83%	2.15%
OILR	1,681,094.99	1,649,172.69	1,655,029.99	-31,922.31	-26,065.00	5,857.30	-1.90%	-1.55%	0.35%
FERC	223,138.95	231,468.90	231,624.48	8,329.95	8,485.53	155.58	3.73%	3.80%	0.07%
ELWT	97,951.48	95,267.41	95,588.70	-2,684.07	-2,362.78	321.29	-2.74%	-2.41%	0.33%
CONS	811,209.37	794,816.54	798,443.69	-16,392.83	-12,765.68	3,627.15	-2.02%	-1.57%	0.45%
TRAD	2,277,927.95	2,227,936.27	2,238,252.01	-49,991.68	-39,675.94	10,315.74	-2.19%	-1.74%	0.45%
TRAN	1,521,235.19	1,523,660.63	1,524,101.62	2,425.44	2,866.43	440.99	0.16%	0.19%	0.03%
COMM	174,543.62	172,640.74	172,954.51	-1,902.88	-1,589.11	313.77	-1.09%	-0.91%	0.18%
FINA	85,295.87	83,987.17	84,235.03	-1,308.70	-1,060.84	247.86	-1.53%	-1.24%	0.29%
SERV	251,371.16	238,770.48	239,894.76	-12,600.68	-11,476.40	1,124.28	-5.01%	-4.57%	0.45%
PUBO	742,849.31	742,269.48	741,990.30	-579.83	-859.01	-279.18	-0.08%	-0.12%	-0.04%

Note: Figure are in IDR million (where applicable).

Appendix 9.4 Impact of RIL Policy on Sector's Domestic Supply, real term at 2007 prices

Sector	Output Value in 2025			Value difference from Base in 2025		Difference	% Change from Base in 2025		Difference
	Base	RIL0	RIL2	RIL0	RIL2	(6) - (5)	RIL0	RIL2	(9) - (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FCRO	298,538.04	303,969.24	304,139.56	5,431.20	5,601.52	170.32	1.82%	1.88%	0.06%
OILP	60,025.47	89,109.00	87,462.18	29,083.53	27,436.71	-1,646.82	48.45%	45.71%	-2.74%
OESC	23,083.14	24,751.72	24,726.31	1,668.59	1,643.18	-25.41	7.23%	7.12%	-0.11%
LIVS	70,151.84	70,134.57	70,259.84	-17.27	108.00	125.27	-0.02%	0.15%	0.18%
TIMB	641,009.74	262,778.62	270,540.24	-378,231.12	-370,469.50	7,761.62	-59.01%	-57.79%	1.21%
OFOP	152,758.44	149,523.15	150,329.24	-3,235.29	-2,429.20	806.09	-2.12%	-1.59%	0.53%
FISH	215,526.50	230,809.40	230,396.53	15,282.90	14,870.03	-412.88	7.09%	6.90%	-0.19%
COAL	671,835.27	699,298.30	696,940.28	27,463.03	25,105.01	-2,358.02	4.09%	3.74%	-0.35%
QUAR	29,990.10	29,460.16	29,584.07	-529.94	-406.03	123.91	-1.77%	-1.35%	0.41%
FBIN	26,879.03	27,675.78	27,662.50	796.75	783.46	-13.29	2.96%	2.91%	-0.05%
TEXL	6,214.95	6,237.41	6,236.84	22.46	21.88	-0.58	0.36%	0.35%	-0.01%
FOIN	60,822.01	58,624.60	59,021.88	-2,197.41	-1,800.13	397.29	-3.61%	-2.96%	0.65%
PAPR	1,242,640.46	1,093,407.78	1,120,195.35	-149,232.68	-122,445.12	26,787.56	-12.01%	-9.85%	2.16%
OILR	38,529.45	38,282.49	38,376.64	-246.97	-152.81	94.15	-0.64%	-0.40%	0.24%
FERC	30,362.01	31,753.47	31,738.74	1,391.46	1,376.73	-14.73	4.58%	4.53%	-0.05%
ELWT	83,453.92	81,236.26	81,501.61	-2,217.66	-1,952.31	265.35	-2.66%	-2.34%	0.32%
CONS	767,272.63	751,767.56	755,196.59	-15,505.07	-12,076.03	3,429.03	-2.02%	-1.57%	0.45%
TRAD	1,769,757.21	1,731,457.65	1,739,416.13	-38,299.56	-30,341.08	7,958.48	-2.16%	-1.71%	0.45%
TRAN	1,045,307.10	1,048,621.83	1,048,715.22	3,314.73	3,408.12	93.39	0.32%	0.33%	0.01%
COMM	131,942.51	130,696.97	130,913.73	-1,245.54	-1,028.78	216.76	-0.94%	-0.78%	0.16%
FINA	25,636.24	25,396.28	25,449.31	-239.96	-186.94	53.03	-0.94%	-0.73%	0.21%
SERV	71,596.60	69,125.30	69,330.26	-2,471.31	-2,266.34	204.97	-3.45%	-3.17%	0.29%
PUBO	709,220.09	708,792.59	708,489.57	-427.50	-730.52	-303.02	-0.06%	-0.10%	-0.04%

Note: Figure are in IDR million (where applicable).

Appendix 9.5 Impact of RIL Policy on Sector's Import, real term at 2007 prices

Sector	Import Value in 2025			Value difference from Base in 2025		Difference	% Change from Base in 2025		Difference
	Base	RIL0	RIL2	RIL0	RIL2	(6) - (5)	RIL0	RIL2	(9) - (8)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FCRO	41,817.49	40,256.04	40,391.02	-1,561.45	-1,426.47	134.99	-3.73%	-3.41%	0.32%
OILP	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
OESC	36,521.13	35,407.32	35,588.71	-1,113.80	-932.41	181.39	-3.05%	-2.55%	0.50%
LIVS	21,602.61	20,879.80	20,953.90	-722.81	-648.71	74.10	-3.35%	-3.00%	0.34%
TIMB	45,952.01	67,228.54	68,365.09	21,276.53	22,413.08	1,136.55	46.30%	48.77%	2.47%
OFOP	1,067.40	1,003.99	1,011.83	-63.41	-55.57	7.84	-5.94%	-5.21%	0.73%
FISH	12,139.15	11,873.12	11,908.05	-266.03	-231.10	34.93	-2.19%	-1.90%	0.29%
COAL	740.57	757.31	756.51	16.74	15.94	-0.79	2.26%	2.15%	-0.11%
QUAR	7,182.42	6,964.15	7,005.89	-218.26	-176.53	41.73	-3.04%	-2.46%	0.58%
FBIN	287,261.71	278,881.88	279,683.94	-8,379.82	-7,577.77	802.06	-2.92%	-2.64%	0.28%
TEXL	39,136.12	38,499.06	38,581.11	-637.05	-555.00	82.05	-1.63%	-1.42%	0.21%
FOIN	79,963.13	78,360.94	78,600.11	-1,602.19	-1,363.02	239.17	-2.00%	-1.70%	0.30%
PAPR	7,511.10	6,943.40	7,042.06	-567.70	-469.05	98.66	-7.56%	-6.24%	1.31%
OILR	1,640,822.73	1,609,188.74	1,614,905.73	-31,633.99	-25,917.00	5,716.99	-1.93%	-1.58%	0.35%
FERC	188,974.34	195,771.46	195,941.67	6,797.12	6,967.33	170.20	3.60%	3.69%	0.09%
ELWT	13,360.86	12,926.72	12,979.09	-434.14	-381.76	52.38	-3.25%	-2.86%	0.39%
CONS	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
TRAD	8,528.86	7,835.87	7,926.37	-692.99	-602.49	90.50	-8.13%	-7.06%	1.06%
TRAN	84,839.72	83,380.15	83,589.37	-1,459.57	-1,250.36	209.21	-1.72%	-1.47%	0.25%
COMM	30,480.03	29,957.59	30,034.50	-522.44	-445.53	76.91	-1.71%	-1.46%	0.25%
FINA	56,461.87	55,442.66	55,628.12	-1,019.21	-833.75	185.46	-1.81%	-1.48%	0.33%
SERV	155,735.45	146,822.84	147,632.67	-8,912.61	-8,102.79	809.83	-5.72%	-5.20%	0.52%
PUBO	24,909.38	24,760.77	24,788.18	-148.62	-121.20	27.41	-0.60%	-0.49%	0.11%

Note: Figure are in IDR million (where applicable).

Appendix 9.6 Impact of RIL Policy on Commodity Export, real term at 2007 prices

Sector	Export Value in 2025			Value difference from Base in 2025		Difference	% Change from Base in 2025		Difference
	Base	RIL0	RIL2	RIL0	RIL2	*(6) - (5)*	RIL0	RIL2	*(9) - (8)*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
FCRO	187,749.49	209,889.55	209,034.85	22,140.06	21,285.36	-854.70	11.79%	11.34%	-0.46%
OILP	267,416.70	413,235.96	404,934.66	145,819.26	137,517.96	-8,301.30	54.53%	51.42%	-3.10%
OESC	89,600.19	113,646.76	112,375.39	24,046.57	22,775.21	-1,271.37	26.84%	25.42%	-1.42%
LIVS	11.55	12.22	12.21	0.67	0.65	-0.01	5.77%	5.65%	-0.12%
TIMB	607,016.60	179,238.44	188,367.31	-427,778.16	-418,649.29	9,128.87	-70.47%	-68.97%	1.50%
OFOP	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
FISH	462,200.49	575,725.08	570,175.11	113,524.59	107,974.62	-5,549.97	24.56%	23.36%	-1.20%
COAL	5,043,544.82	5,536,354.31	5,478,993.32	492,809.49	435,448.50	-57,360.99	9.77%	8.63%	-1.14%
QUAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
FBIN	168.02	187.12	186.19	19.09	18.17	-0.92	11.36%	10.81%	-0.55%
TEXL	0.40	0.41	0.41	0.01	0.01	0.00	3.08%	2.77%	-0.31%
FOIN	12.84	12.11	12.25	-0.73	-0.59	0.14	-5.72%	-4.61%	1.11%
PAPR	2,719,690.16	2,240,598.83	2,326,675.02	-479,091.33	-393,015.14	86,076.19	-17.62%	-14.45%	3.16%
OILR	7.47	7.72	7.71	0.25	0.24	-0.01	3.32%	3.23%	-0.09%
FERC	269.05	292.25	290.56	23.20	21.51	-1.68	8.62%	8.00%	-0.63%
ELWT	0.66	0.66	0.66	0.00	0.00	0.00	-0.24%	-0.23%	0.01%
CONS	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
TRAD	261,798.24	260,187.64	260,932.16	-1,610.60	-866.08	744.52	-0.62%	-0.33%	0.28%
TRAN	796,288.06	815,360.97	813,469.82	19,072.91	17,181.76	-1,891.15	2.40%	2.16%	-0.24%
COMM	340.82	340.25	340.49	-0.57	-0.33	0.25	-0.17%	-0.10%	0.07%
FINA	7.93	7.88	7.89	-0.05	-0.03	0.01	-0.59%	-0.43%	0.16%
SERV	20.12	19.61	19.65	-0.51	-0.47	0.04	-2.53%	-2.34%	0.19%
PUBO	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%

Note: Figure are in IDR million (where applicable).

Appendix 9.7 Change in Commodity Output Price

Commodity	Change from 2015			Difference
	Base	RIL0	RIL2	RIL2-RIL0
(1)	*(2)*	*(3)*	*(4)*	*(6)*
FCRO	100.10%	98.69%	98.68%	-0.01%
OILP	100.00%	102.49%	102.29%	-0.20%
OESC	100.05%	100.64%	100.55%	-0.09%
LIVS	100.07%	98.61%	98.62%	0.01%
TIMB	100.11%	182.32%	179.35%	-2.97%
OFOP	100.16%	97.90%	97.99%	0.09%
FISH	100.07%	99.60%	99.54%	-0.06%
COAL	99.99%	102.65%	102.47%	-0.18%
QUAR	99.99%	100.41%	100.54%	0.13%
FBIN	100.06%	99.19%	99.19%	0.00%
TEXL	99.98%	101.68%	101.61%	-0.07%
FOIN	100.03%	104.25%	103.77%	-0.48%
PAPR	99.99%	104.18%	103.71%	-0.47%
OILR	100.01%	100.43%	100.43%	0.00%
FERC	99.97%	101.12%	101.16%	0.04%
ELWT	99.99%	101.81%	101.74%	-0.07%
CONS	99.99%	102.63%	102.43%	-0.20%
TRAD	99.89%	100.19%	100.26%	0.07%
TRAN	99.97%	100.70%	100.74%	0.04%
COMM	99.96%	101.44%	101.40%	-0.04%
FINA	100.01%	102.35%	102.23%	-0.12%
SERV	99.94%	101.08%	101.06%	-0.02%
PUBO	100.14%	102.77%	102.67%	-0.10%

Appendix 9.8 Change in Composite (Armington) Commodity Price

Commodity	Change from 2015 price			
	Base	RIL0	RIL2	RIL2-RIL0
(1)	(2)	(3)	(4)	(6)
FCRO	100.13%	96.67%	96.76%	0.09%
OILP	100.07%	99.89%	99.79%	-0.10%
OESC	100.11%	98.01%	98.10%	0.09%
LIVS	100.05%	99.64%	99.59%	-0.05%
TIMB	100.22%	114.16%	112.23%	-1.93%
OFOP	100.15%	97.92%	98.02%	0.10%
FISH	100.24%	92.15%	92.50%	0.35%
COAL	99.91%	99.41%	99.65%	0.24%
QUAR	99.99%	100.92%	100.98%	0.06%
FBIN	100.00%	102.73%	102.52%	-0.21%
TEXL	99.99%	102.88%	102.67%	-0.21%
FOIN	100.00%	103.57%	103.23%	-0.34%
PAPR	100.01%	106.51%	105.56%	-0.95%
OILR	99.99%	103.00%	102.78%	-0.22%
FERC	99.99%	102.80%	102.61%	-0.19%
ELWT	99.99%	101.98%	101.89%	-0.09%
CONS	99.99%	102.63%	102.43%	-0.20%
TRAD	99.88%	99.78%	99.90%	0.12%
TRAN	99.96%	99.20%	99.42%	0.22%
COMM	99.96%	101.74%	101.66%	-0.08%
FINA	99.99%	102.84%	102.64%	-0.20%
SERV	99.98%	102.44%	102.27%	-0.17%
PUBO	100.13%	102.78%	102.68%	-0.10%

Appendix 9.9 Change in Domestic Commodity Price

Commodity	Change from 2015 price			
	Base	RIL0	RIL2	RIL2-RIL0
(1)	*(2)*	*(3)*	*(4)*	*(6)*
FCRO	100.15%	95.80%	95.94%	0.14%
OILP	100.07%	99.89%	99.79%	-0.10%
OESC	100.30%	90.40%	90.93%	0.53%
LIVS	100.07%	98.61%	98.62%	0.01%
TIMB	100.24%	229.98%	225.72%	-4.26%
OFOP	100.16%	97.90%	97.99%	0.09%
FISH	100.25%	91.56%	91.94%	0.38%
COAL	99.91%	99.40%	99.64%	0.24%
QUAR	99.99%	100.41%	100.54%	0.13%
FBIN	100.06%	99.17%	99.17%	0.00%
TEXL	99.98%	101.68%	101.61%	-0.07%
FOIN	100.03%	104.25%	103.77%	-0.48%
PAPR	100.01%	106.53%	105.58%	-0.95%
OILR	100.01%	100.43%	100.43%	0.00%
FERC	99.96%	101.10%	101.15%	0.05%
ELWT	99.99%	101.81%	101.74%	-0.07%
CONS	99.99%	102.63%	102.43%	-0.20%
TRAD	99.88%	99.77%	99.89%	0.12%
TRAN	99.95%	98.88%	99.14%	0.26%
COMM	99.96%	101.44%	101.39%	-0.05%
FINA	100.01%	102.35%	102.23%	-0.12%
SERV	99.94%	101.08%	101.05%	-0.03%
PUBO	100.14%	102.77%	102.67%	-0.10%

Appendix 11.1Sensitivity Analysis results of the RIL0 Scenario with respect to CES of primary inputs in Agricultural Group

Macrovariable	Value in 2025 (Baseline)			Value in 2025 (Under RIL0)			Value Change from Baseline (in 2025)			% Change from Baseline (in 2025)		
	Original CES	HIGH CES	LOW CES	Original CES	HIGH CES	LOW CES	ORI CES	HIGH CES	LOW CES	ORI CES	HIGH CES	LOW CES
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FCRO	486,281.42	486,805.78	485,275.21	514,242.64	515,036.26	512,726.24	27,961.22	28,230.48	27,451.03	5.75%	5.80%	5.66%
OILP	327,438.93	327,021.30	328,179.27	502,291.96	499,881.11	505,016.03	174,853.03	172,859.81	176,836.76	53.40%	52.86%	53.88%
OESC	112,684.14	112,703.80	112,631.73	138,610.31	138,158.22	139,098.43	25,926.17	25,454.42	26,466.70	23.01%	22.59%	23.50%
LIVS	70,164.12	70,208.97	70,076.47	70,147.82	70,196.74	70,062.20	-16.31	-12.23	-14.27	-0.02%	-0.02%	-0.02%
TIMB	1,248,013.35	1,249,543.71	1,244,989.05	750,826.63	749,442.02	751,992.63	-497,186.71	-500,101.70	-492,996.43	-39.84%	-40.02%	-39.60%
OFOP	152,759.29	152,825.82	152,635.09	149,530.23	149,596.76	149,414.90	-3,229.06	-3,229.06	-3,220.19	-2.11%	-2.11%	-2.11%
FISH	677,720.48	678,432.56	676,316.11	807,892.35	806,112.15	809,276.94	130,171.86	127,679.59	132,960.83	19.21%	18.82%	19.66%
COAL	5,715,450.61	5,712,645.03	5,721,391.82	6,235,802.18	6,245,374.14	6,226,725.32	520,351.58	532,729.11	505,333.50	9.10%	9.33%	8.83%
QUAR	29,990.44	30,001.75	29,968.67	29,461.11	29,473.30	29,440.22	-529.32	-528.45	-528.45	-1.76%	-1.76%	-1.76%
FBIN	27,047.42	27,071.03	27,001.00	27,862.58	27,901.93	27,794.13	815.16	830.90	793.13	3.01%	3.07%	2.94%
TEXL	6,215.40	6,221.91	6,202.74	6,237.63	6,247.94	6,221.18	22.24	26.03	18.44	0.36%	0.42%	0.30%
FOIN	60,834.77	60,871.88	60,764.07	58,639.63	58,669.67	58,583.07	-2,195.14	-2,202.21	-2,181.00	-3.61%	-3.62%	-3.59%
PAPR	3,962,401.50	3,965,982.05	3,955,240.40	3,335,804.75	3,329,221.15	3,341,464.33	-626,596.75	-636,760.90	-613,776.06	-15.81%	-16.06%	-15.52%
OILR	38,536.69	38,554.58	38,505.36	38,290.57	38,314.07	38,253.66	-246.11	-240.52	-251.71	-0.64%	-0.62%	-0.65%
FERC	30,631.30	30,642.86	30,609.06	32,045.38	32,044.49	32,034.70	1,414.08	1,401.63	1,425.64	4.62%	4.57%	4.66%
ELWT	83,454.18	83,502.63	83,364.55	81,237.75	81,324.95	81,111.79	-2,216.43	-2,177.68	-2,252.77	-2.66%	-2.61%	-2.70%
CONS	767,263.46	767,597.61	766,684.26	751,803.24	752,092.84	751,268.59	-15,460.22	-15,504.77	-15,415.66	-2.01%	-2.02%	-2.01%
TRAD	2,031,533.83	2,032,359.44	2,030,059.53	1,991,786.56	1,992,907.03	1,990,017.39	-39,747.27	-39,452.41	-40,042.13	-1.96%	-1.94%	-1.97%
TRAN	1,841,573.65	1,841,947.19	1,840,986.65	1,864,199.76	1,865,907.40	1,861,958.50	22,626.11	23,960.20	20,971.85	1.23%	1.30%	1.14%
COMM	132,284.39	132,326.58	132,200.01	131,037.90	131,133.79	130,903.67	-1,246.48	-1,192.79	-1,296.34	-0.94%	-0.90%	-0.98%
FINA	25,643.85	25,656.50	25,620.02	25,404.07	25,406.31	25,392.90	-239.77	-250.20	-227.11	-0.94%	-0.98%	-0.89%
SERV	71,615.75	71,649.01	71,559.62	69,146.17	69,208.53	69,058.86	-2,469.58	-2,440.48	-2,500.76	-3.45%	-3.41%	-3.49%
PUBO	709,225.29	709,266.29	709,102.28	708,794.76	708,794.76	708,733.26	-430.53	-471.53	-369.03	-0.06%	-0.07%	-0.05%